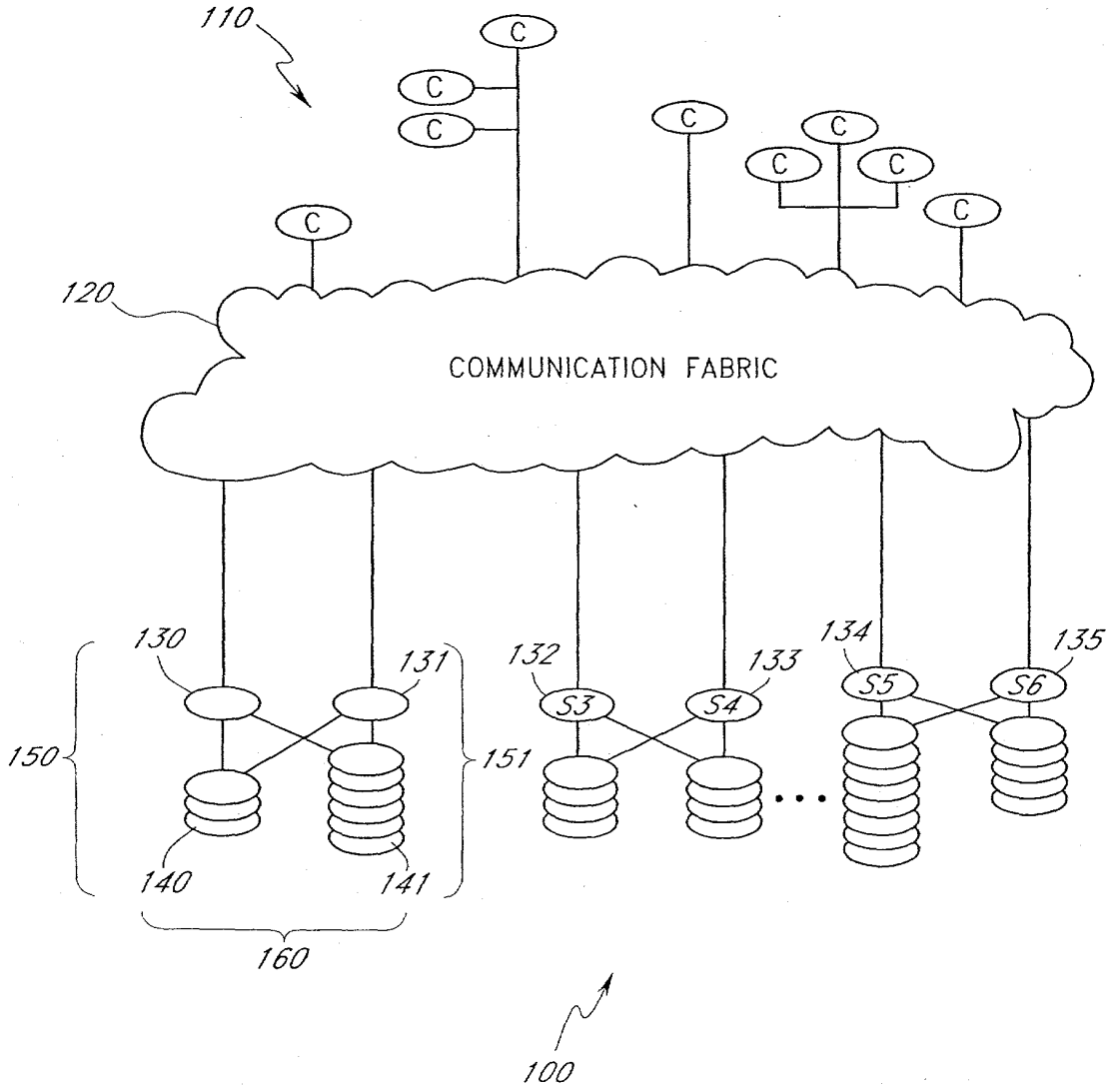

110
C
C
C
C
C
C
C
C
C
120
COMMUNICATION FABRIC
130
131
132
133
134
135
S3
S4
S5
S6
150
151
140
141
160
100

FIG. 1

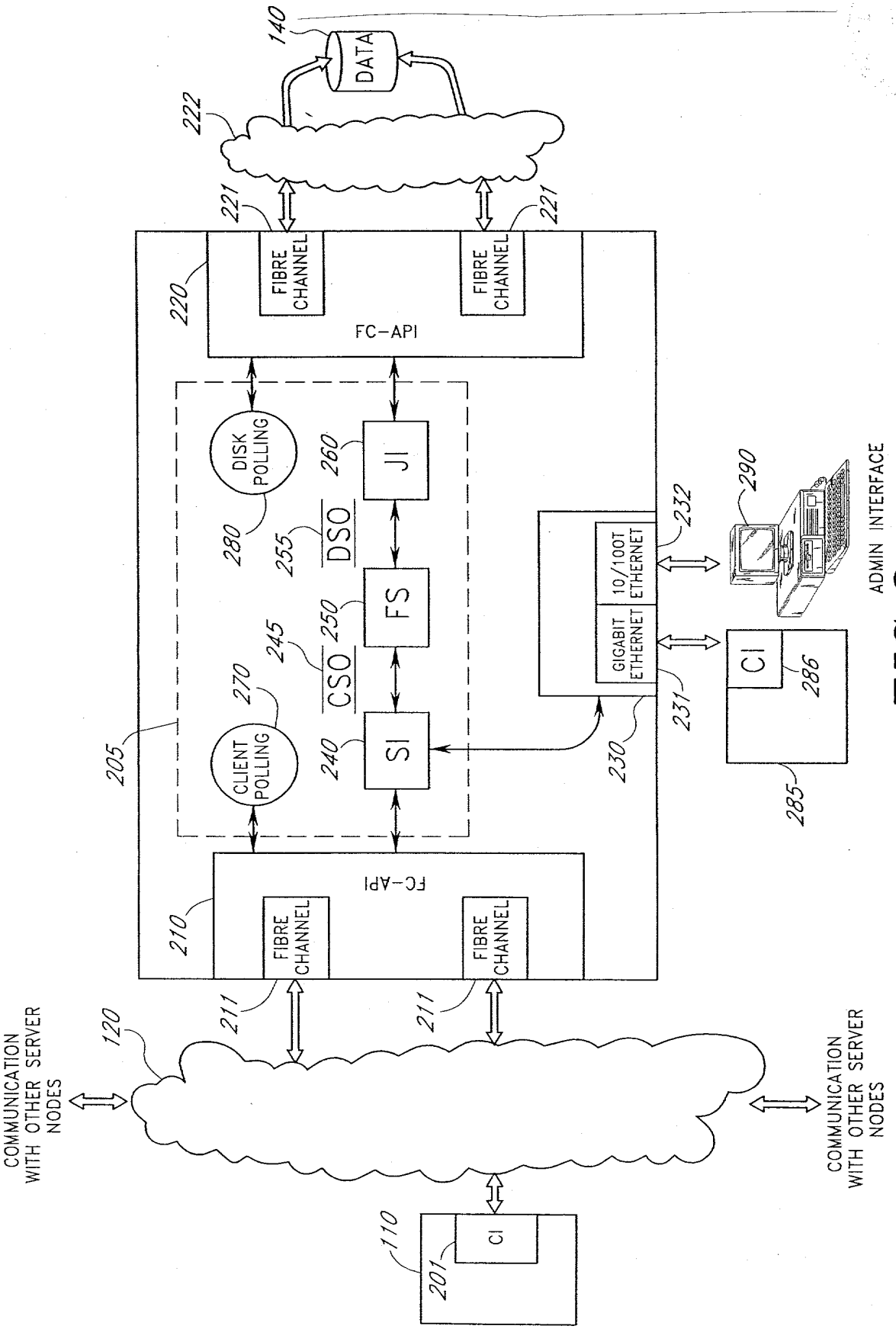

140
DATA
222
221
221
FIBRE CHANNEL
FIBRE CHANNEL
220
FC-API
DISK POLLING
280
260
JI
255
DSO
250
FS
245
CSO
270
CLIENT POLLING
240
SI
205
230
232
10/100T ETHERNET
GIGABIT ETHERNET
231
290
ADMIN INTERFACE
CI
286
285
FC-API
210
FIBRE CHANNEL
FIBRE CHANNEL
211
211
120
COMMUNICATION WITH OTHER SERVER NODES
COMMUNICATION WITH OTHER SERVER NODES
110
CI
201

FIG.2

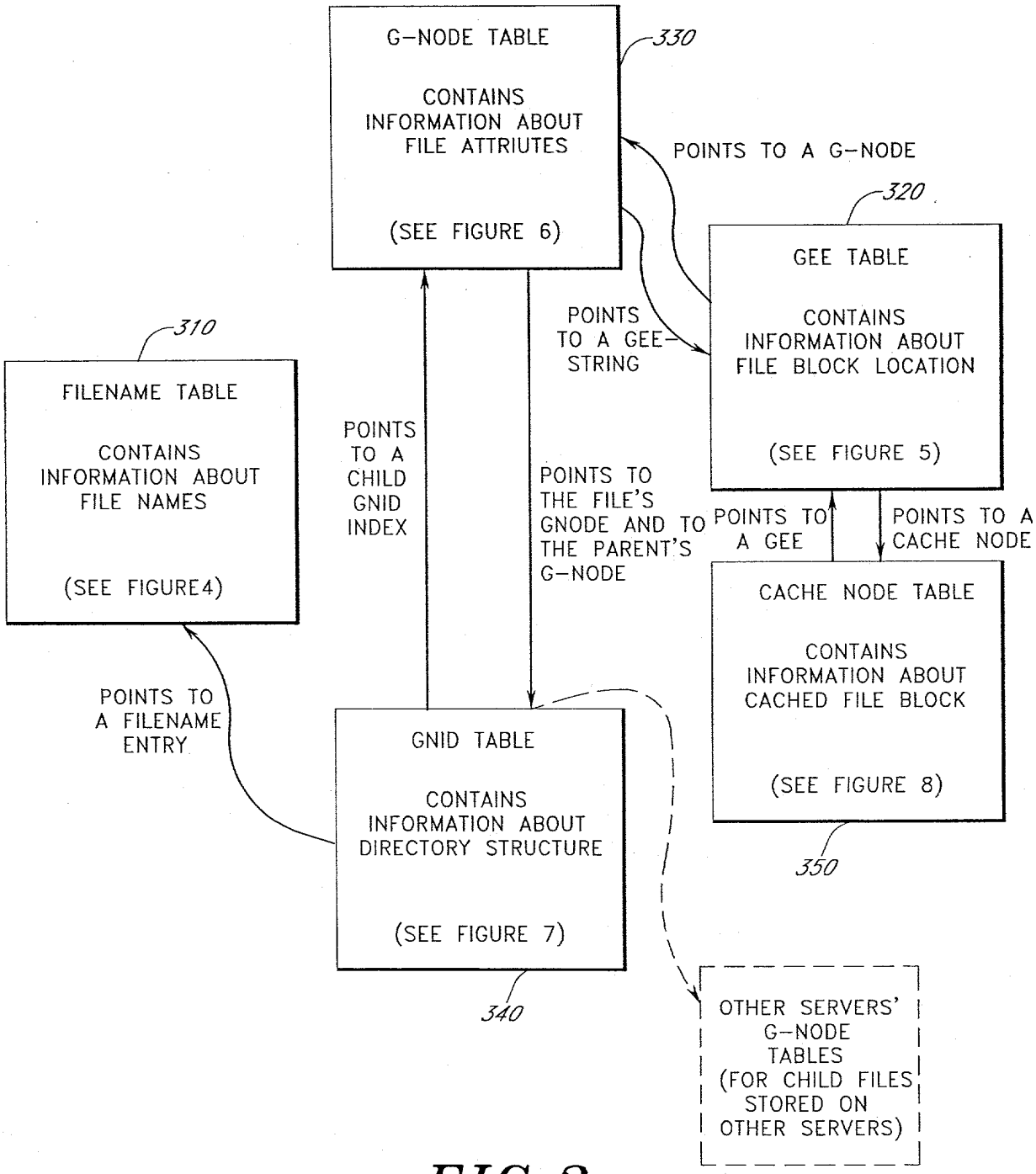

G-NODE TABLE
CONTAINS INFORMATION ABOUT FILE ATTRIUTES
(SEE FIGURE 6)
330
POINTS TO A G-NODE
320
GEE TABLE
CONTAINS INFORMATION ABOUT FILE BLOCK LOCATION
(SEE FIGURE 5)
POINTS TO A GEE-STRING
310
FILENAME TABLE
CONTAINS INFORMATION ABOUT FILE NAMES
(SEE FIGURE4)
POINTS TO A CHILD GNID INDEX
POINTS TO THE FILE'S GNODE AND TO THE PARENT'S G-NODE
POINTS TO A GEE
POINTS TO A CACHE NODE
CACHE NODE TABLE
CONTAINS INFORMATION ABOUT CACHED FILE BLOCK
(SEE FIGURE 8)
350
POINTS TO A FILENAME ENTRY
GNID TABLE
CONTAINS INFORMATION ABOUT DIRECTORY STRUCTURE
(SEE FIGURE 7)
340
OTHER SERVERS' G-NODE TABLES (FOR CHILD FILES STORED ON OTHER SERVERS)

FIG.3

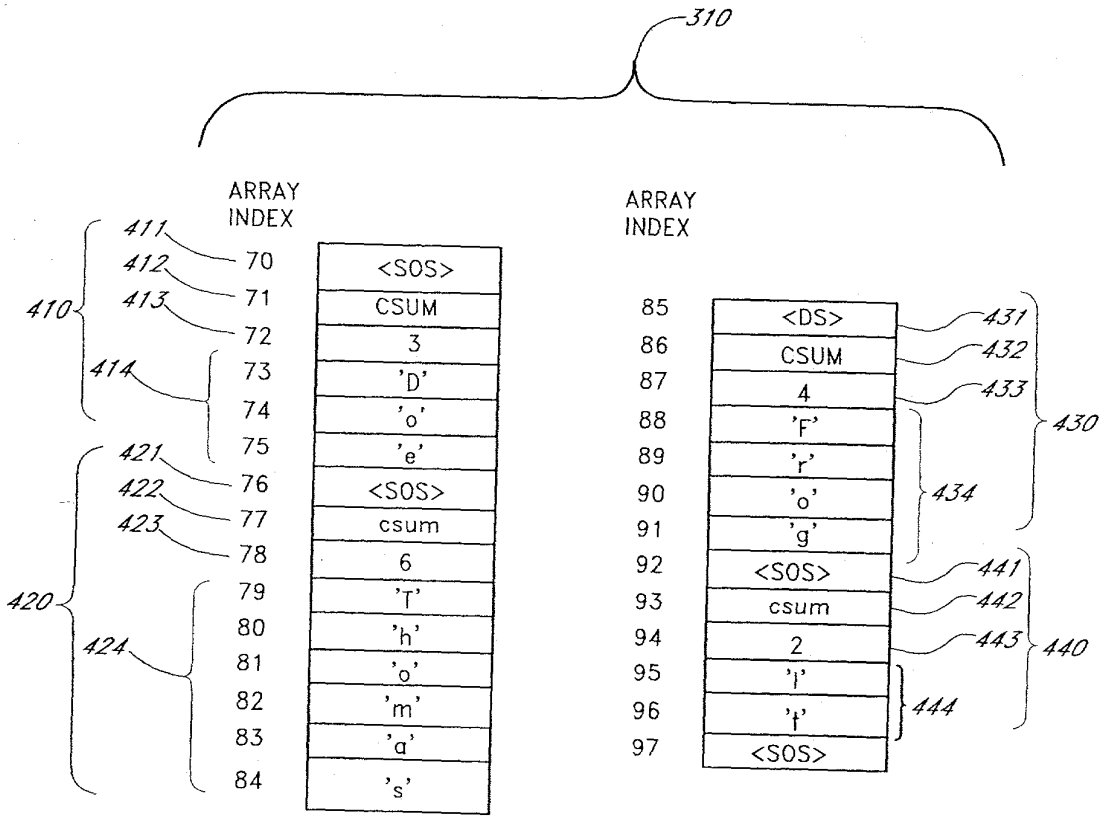

310
ARRAY INDEX
ARRAY INDEX
410
411
412
413
414
420
421
422
423
424
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
<SOS>
CSUM
3
'D'
'o'
'e'
<SOS>
csum
6
'T'
'h'
'o'
'm'
'a'
's'
85
86
87
88
89
90
91
92
93
94
95
96
97
<DS>
CSUM
4
'F'
'r'
'o'
'g'
<SOS>
csum
2
'l'
'f'
<SOS>
431
432
433
434
430
441
442
443
444
440

FIG. 4

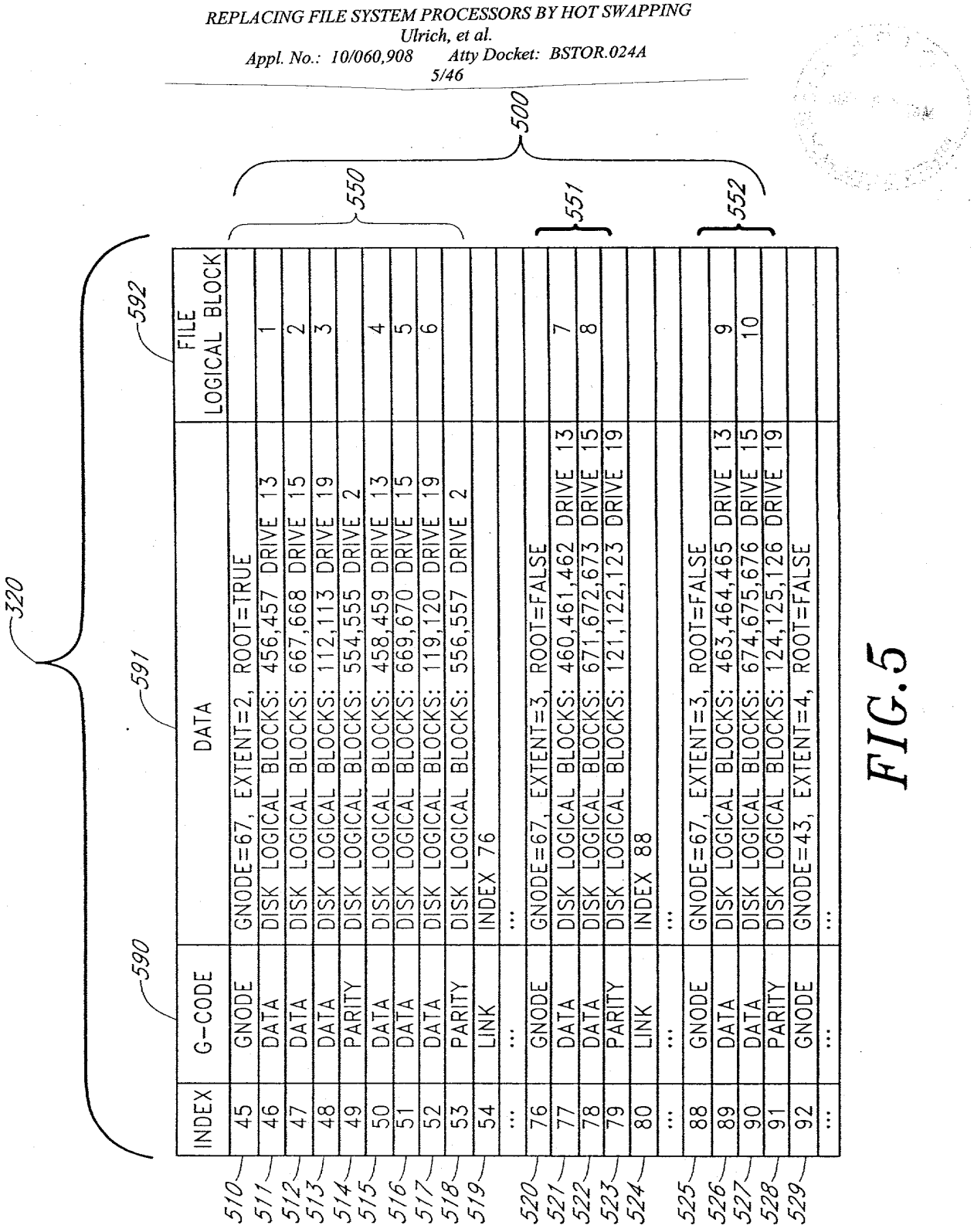

320
590
591
592
500
550
551
552
INDEX
G-CODE
DATA
FILE LOGICAL BLOCK
45 GNODE GNODE=67, EXTENT=2, ROOT=TRUE
46 DATA DISK LOGICAL BLOCKS: 456,457 DRIVE 13 1
47 DATA DISK LOGICAL BLOCKS: 667,668 DRIVE 15 2
48 DATA DISK LOGICAL BLOCKS: 112,113 DRIVE 19 3
49 PARITY DISK LOGICAL BLOCKS: 554,555 DRIVE 2
50 DATA DISK LOGICAL BLOCKS: 458,459 DRIVE 13 4
51 DATA DISK LOGICAL BLOCKS: 669,670 DRIVE 15 5
52 DATA DISK LOGICAL BLOCKS: 119,120 DRIVE 19 6
53 PARITY DISK LOGICAL BLOCKS: 556,557 DRIVE 2
54 LINK INDEX 76
... ...
76 GNODE GNODE=67, EXTENT=3, ROOT=FALSE
77 DATA DISK LOGICAL BLOCKS: 460,461,462 DRIVE 13 7
78 DATA DISK LOGICAL BLOCKS: 671,672,673 DRIVE 15 8
79 PARITY DISK LOGICAL BLOCKS: 121,122,123 DRIVE 19
80 LINK INDEX 88
... ...
88 GNODE GNODE=67, EXTENT=3, ROOT=FALSE
89 DATA DISK LOGICAL BLOCKS: 463,464,465 DRIVE 13 9
90 DATA DISK LOGICAL BLOCKS: 674,675,676 DRIVE 15 10
91 PARITY DISK LOGICAL BLOCKS: 124,125,126 DRIVE 19
92 GNODE GNODE=43, EXTENT=4, ROOT=FALSE
... ...
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529

FIG. 5

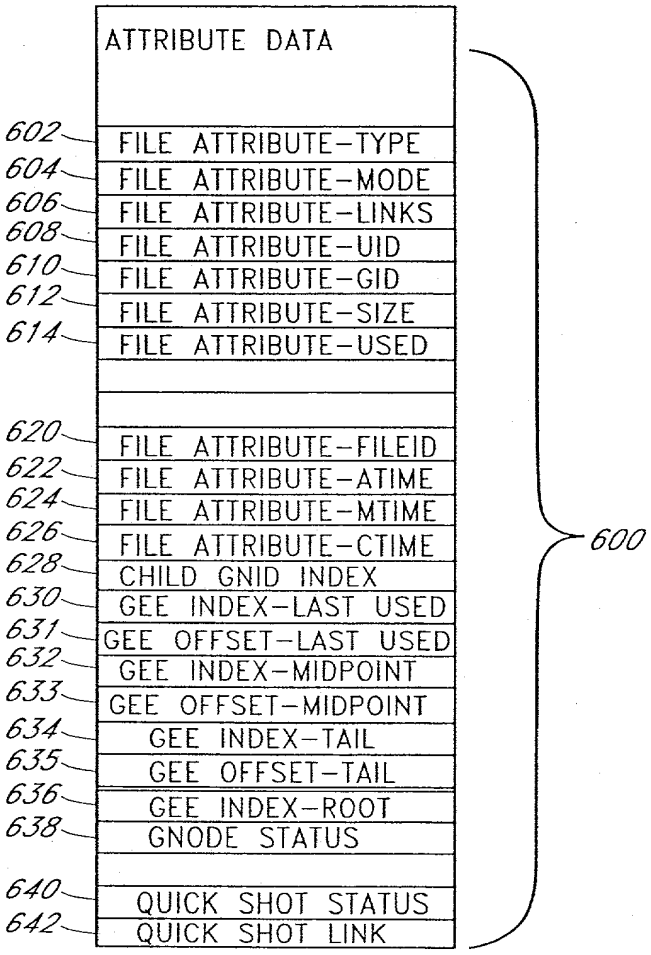

ATTRIBUTE DATA
602
FILE ATTRIBUTE-TYPE
604
FILE ATTRIBUTE-MODE
606
FILE ATTRIBUTE-LINKS
608
FILE ATTRIBUTE-UID
610
FILE ATTRIBUTE-GID
612
FILE ATTRIBUTE-SIZE
614
FILE ATTRIBUTE-USED
620
FILE ATTRIBUTE-FILEID
622
FILE ATTRIBUTE-ATIME
624
FILE ATTRIBUTE-MTIME
626
FILE ATTRIBUTE-CTIME
628
CHILD GNID INDEX
630
GEE INDEX-LAST USED
631
GEE OFFSET-LAST USED
632
GEE INDEX-MIDPOINT
633
GEE OFFSET-MIDPOINT
634
GEE INDEX-TAIL
635
GEE OFFSET-TAIL
636
GEE INDEX-ROOT
638
GNODE STATUS
640
QUICK SHOT STATUS
642
QUICK SHOT LINK
600

FIG. 6

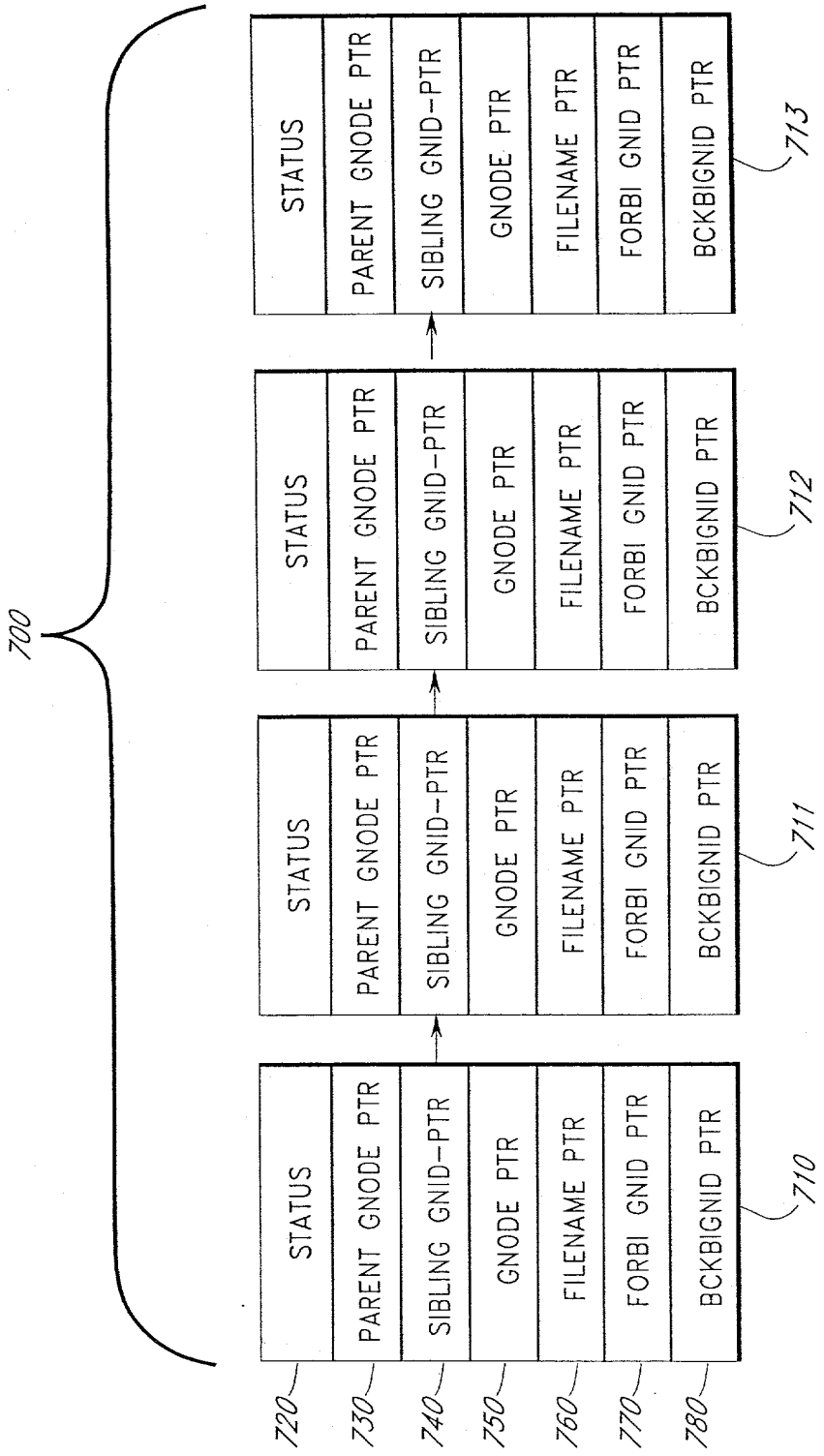

700
STATUS
PARENT GNODE PTR
SIBLING GNID-PTR
GNODE PTR
FILENAME PTR
FORBI GNID PTR
BCKBIGNID PTR
710
711
712
713
720
730
740
750
760
770
780

FIG. 7

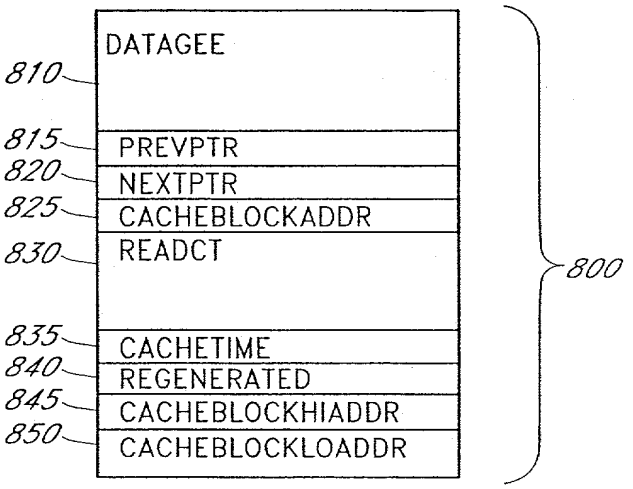

DATAGEE
810
815
PREVPTR
820
NEXTPTR
825
CACHEBLOCKADDR
830
READCT
835
CACHETIME
840
REGENERATED
845
CACHEBLOCKHIADDR
850
CACHEBLOCKLOADDR
800

FIG. 8A

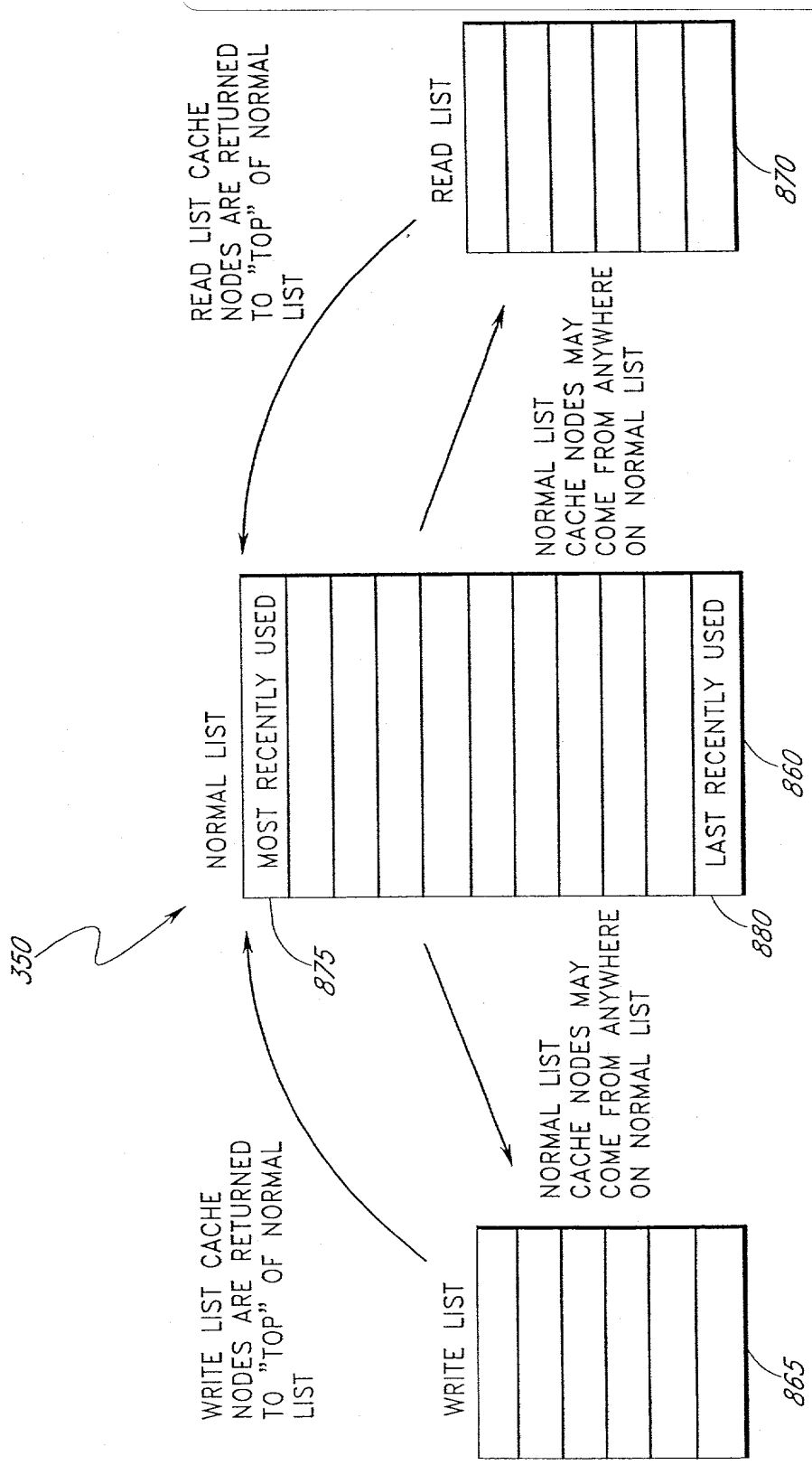

350
NORMAL LIST
MOST RECENTLY USED
LAST RECENTLY USED
860
875
880
READ LIST
870
READ LIST CACHE NODES ARE RETURNED TO "TOP" OF NORMAL LIST
NORMAL LIST CACHE NODES MAY COME FROM ANYWHERE ON NORMAL LIST
WRITE LIST
865
WRITE LIST CACHE NODES ARE RETURNED TO "TOP" OF NORMAL LIST
NORMAL LIST CACHE NODES MAY COME FROM ANYWHERE ON NORMAL LIST

FIG. 8B

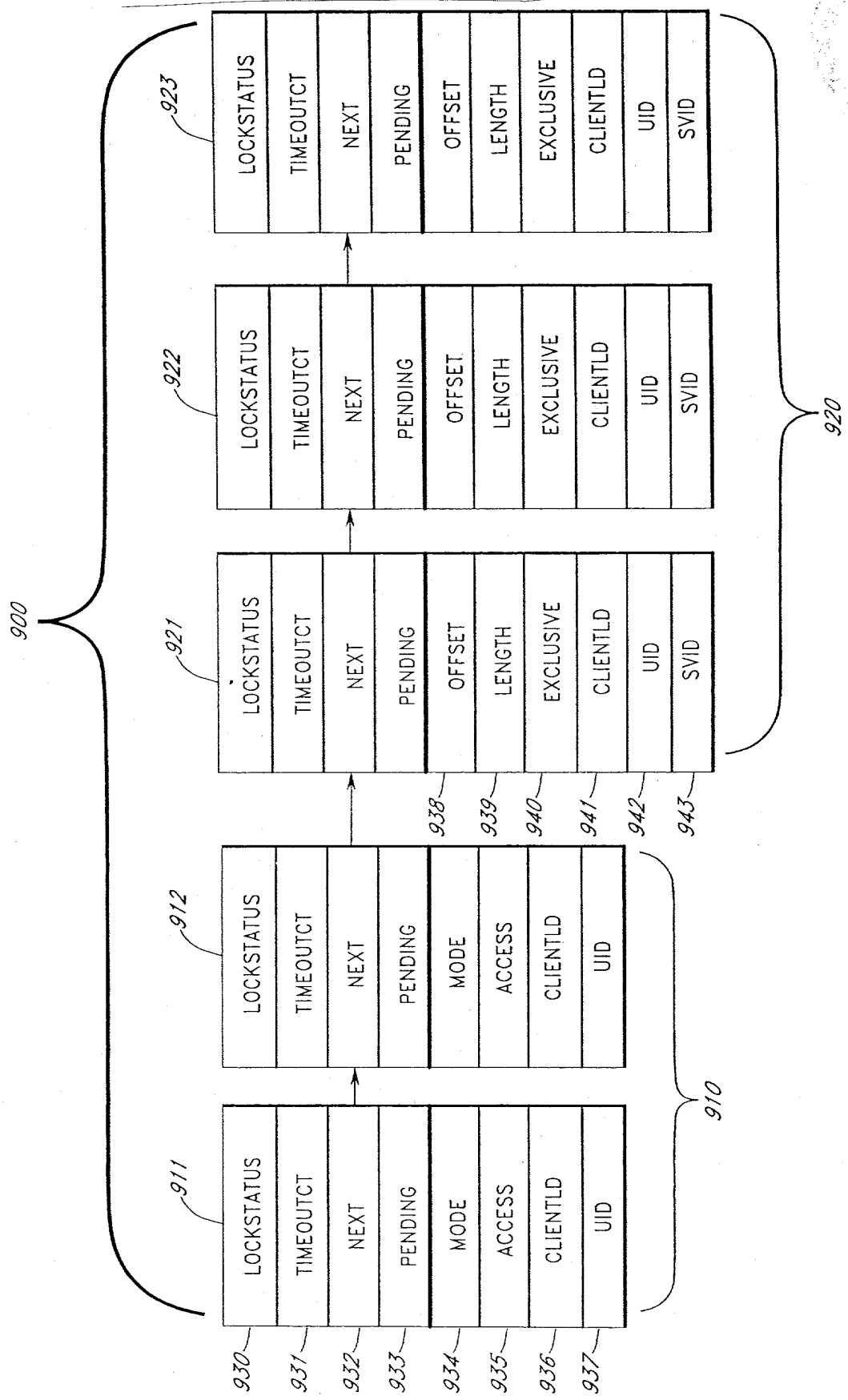

900
910
911
912
920
921
922
923
LOCKSTATUS
TIMEOUTCT
NEXT
PENDING
MODE
ACCESS
CLIENTLD
UID
OFFSET
LENGTH
EXCLUSIVE
SVID
930
931
932
933
934
935
936
937
938
939
940
941
942
943

FIG. 9

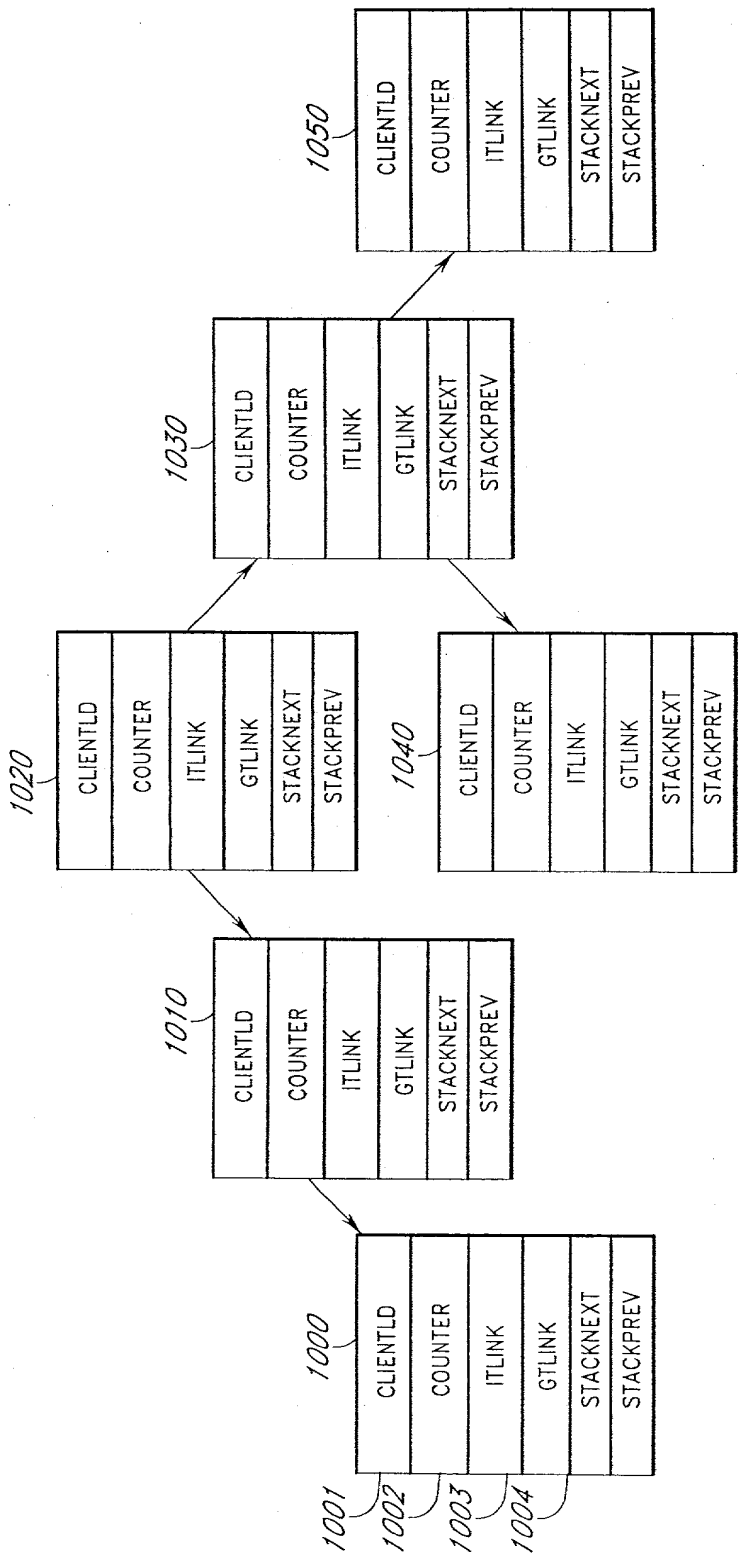

1000
CLIENTLD
COUNTER
ITLINK
GTLINK
STACKNEXT
STACKPREV
1001
1002
1003
1004
1010
1020
1030
1040
1050

FIG. 10

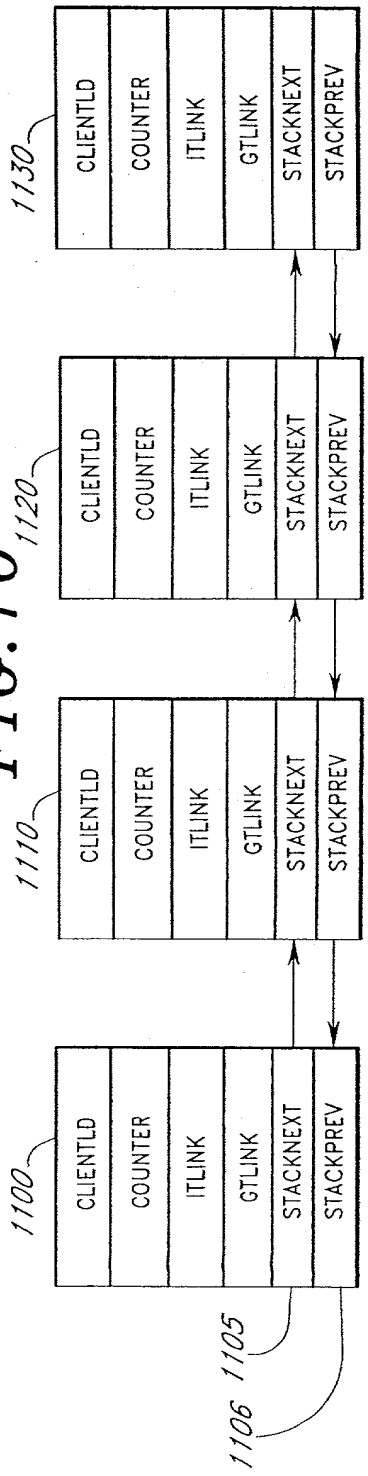

1100
1105
1106
1110
1120
1130

FIG. 11

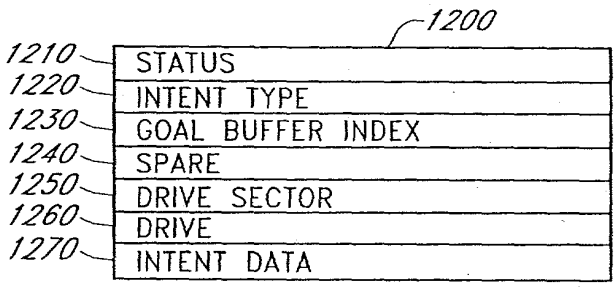

1200
1210
STATUS
1220
INTENT TYPE
1230
GOAL BUFFER INDEX
1240
SPARE
1250
DRIVE SECTOR
1260
DRIVE
1270
INTENT DATA

FIG. 12

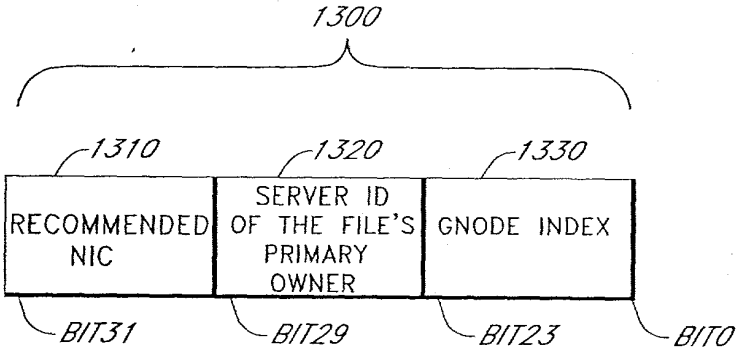

1300
1310
1320
1330
RECOMMENDED NIC
SERVER ID OF THE FILE'S PRIMARY OWNER
GNODE INDEX
BIT31
BIT29
BIT23
BIT0

FIG. 13

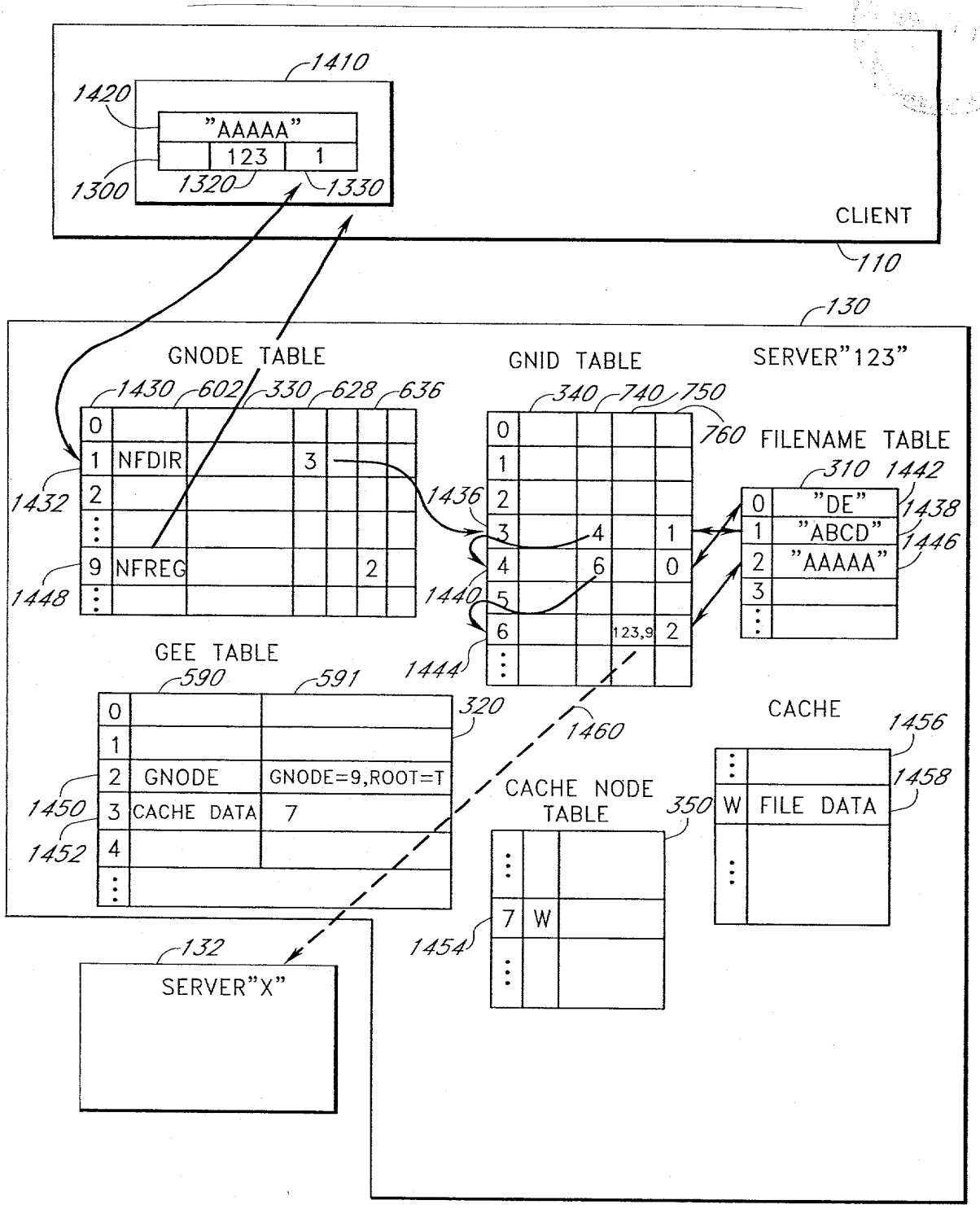

1410
1420
"AAAAA"
123
1
1300
1320
1330
CLIENT
110
130
GNODE TABLE
GNID TABLE
SERVER"123"
1430
602
330
628
636
340
740
750
760
FILENAME TABLE
310
1442
0
1
2
3
9
NFDIR
NFREG
1432
1448
1436
1440
1444
"DE"
"ABCD"
"AAAAA"
1438
1446
4
6
123,9
GEE TABLE
590
591
320
1460
CACHE
1456
1458
GNODE
GNODE=9,ROOT=T
CACHE DATA
7
1450
1452
CACHE NODE TABLE
350
W
FILE DATA
1454
132
SERVER"X"

FIG. 14A

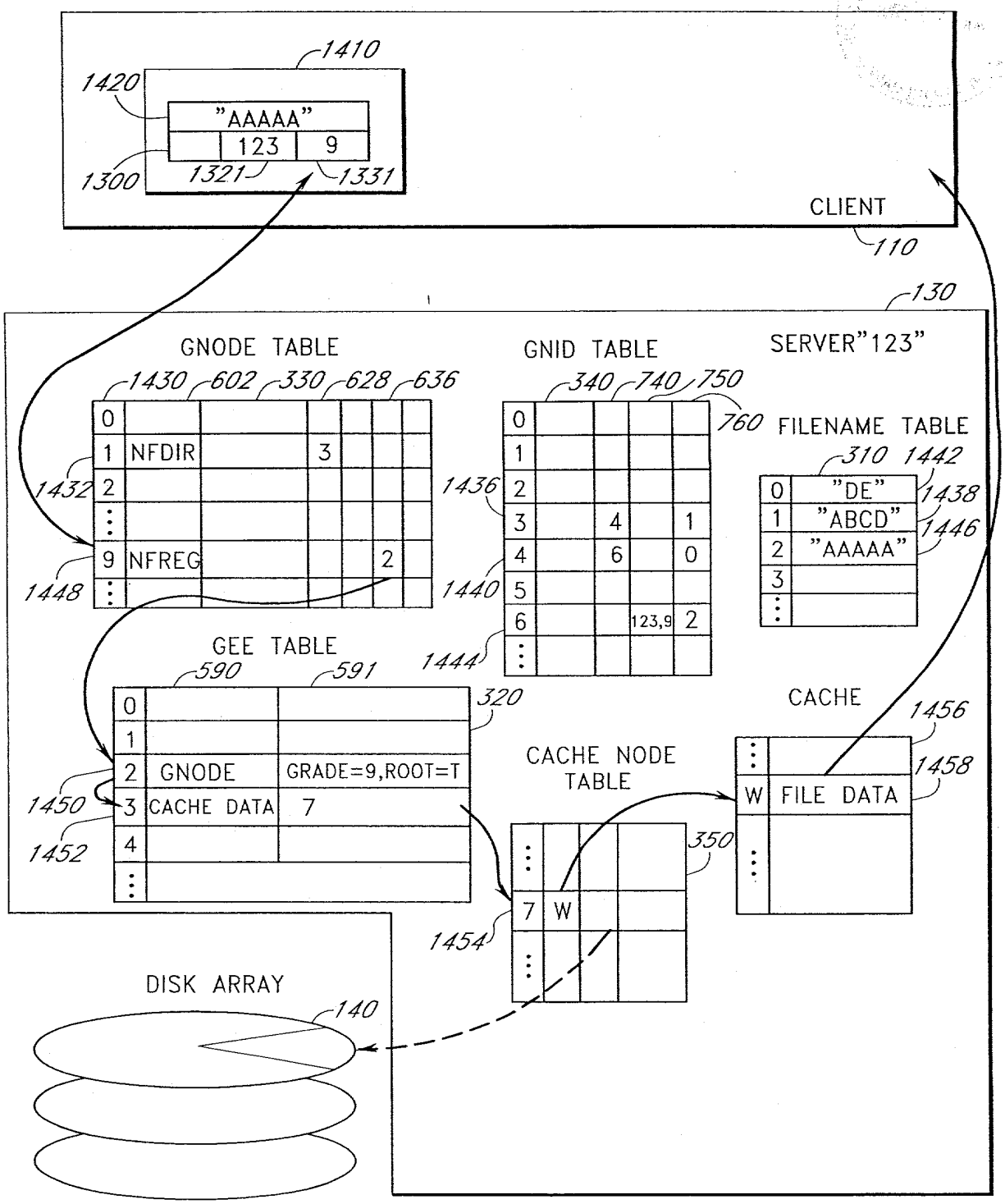

1410
1420
"AAAAA"
123
9
1300
1321
1331
CLIENT
110
130
SERVER"123"
GNODE TABLE
1430
602
330
628
636
0
1
NFDIR
3
1432
2
9
NFREG
2
1448
GNID TABLE
340
740
750
760
0
1
2
3
4
1
4
6
0
5
6
123,9
2
1436
1440
1444
FILENAME TABLE
310
1442
0
"DE"
1438
1
"ABCD"
1446
2
"AAAAA"
3
GEE TABLE
590
591
320
0
1
2
GNODE
GRADE=9,ROOT=T
3
CACHE DATA
7
4
1450
1452
CACHE NODE TABLE
350
7
W
1454
CACHE
1456
W
FILE DATA
1458
DISK ARRAY
140

FIG. 14B

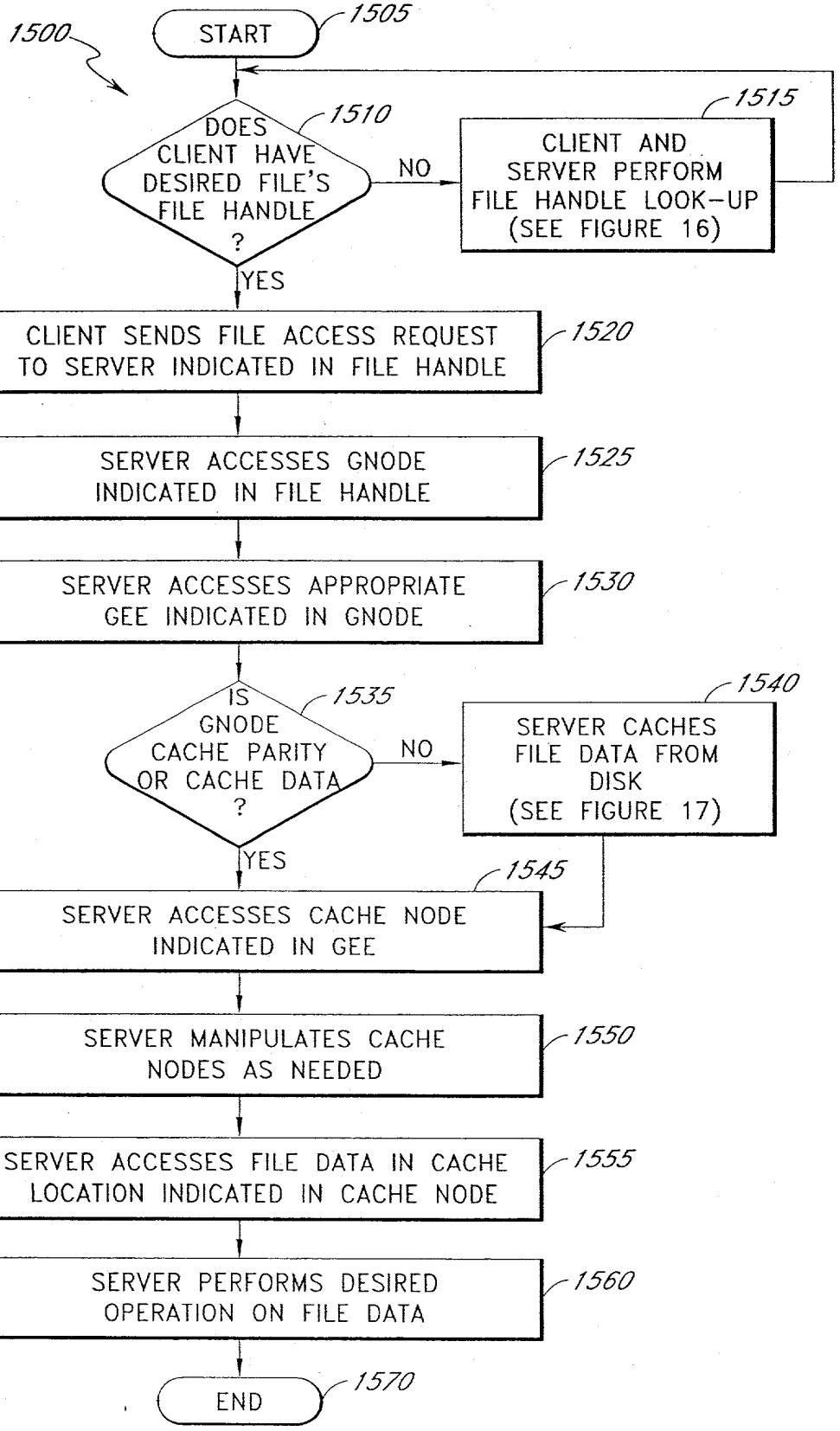

1500
START
1505
DOES CLIENT HAVE DESIRED FILE'S FILE HANDLE ?
1510
NO
CLIENT AND SERVER PERFORM FILE HANDLE LOOK-UP (SEE FIGURE 16)
1515
YES
CLIENT SENDS FILE ACCESS REQUEST TO SERVER INDICATED IN FILE HANDLE
1520
SERVER ACCESSES GNODE INDICATED IN FILE HANDLE
1525
SERVER ACCESSES APPROPRIATE GEE INDICATED IN GNODE
1530
IS GNODE CACHE PARITY OR CACHE DATA ?
1535
NO
SERVER CACHES FILE DATA FROM DISK (SEE FIGURE 17)
1540
YES
SERVER ACCESSES CACHE NODE INDICATED IN GEE
1545
SERVER MANIPULATES CACHE NODES AS NEEDED
1550
SERVER ACCESSES FILE DATA IN CACHE LOCATION INDICATED IN CACHE NODE
1555
SERVER PERFORMS DESIRED OPERATION ON FILE DATA
1560
END
1570

FIG. 15

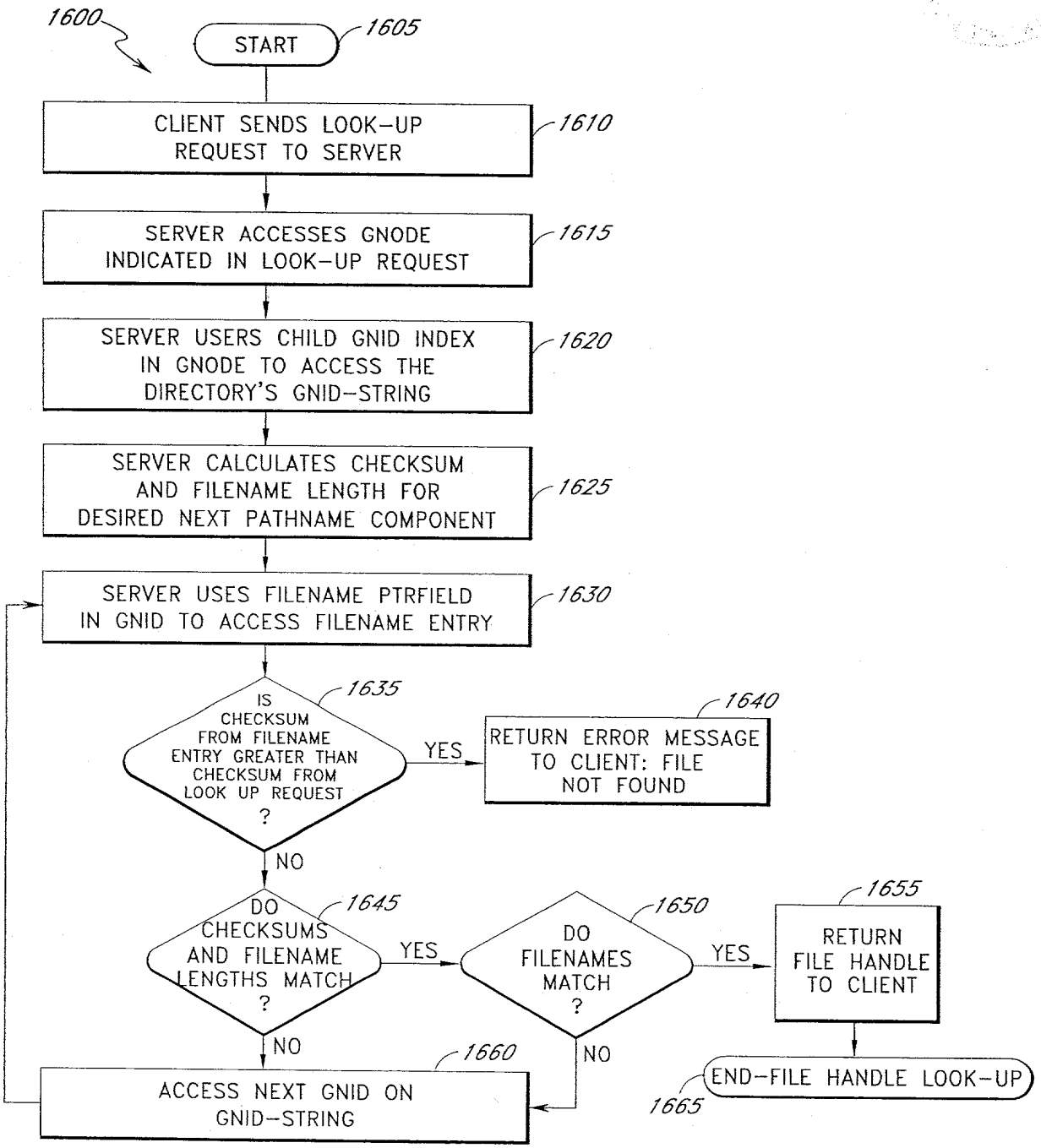

1600
START
1605
CLIENT SENDS LOOK-UP REQUEST TO SERVER
1610
SERVER ACCESSES GNODE INDICATED IN LOOK-UP REQUEST
1615
SERVER USERS CHILD GNID INDEX IN GNODE TO ACCESS THE DIRECTORY'S GNID-STRING
1620
SERVER CALCULATES CHECKSUM AND FILENAME LENGTH FOR DESIRED NEXT PATHNAME COMPONENT
1625
SERVER USES FILENAME PTRFIELD IN GNID TO ACCESS FILENAME ENTRY
1630
IS CHECKSUM FROM FILENAME ENTRY GREATER THAN CHECKSUM FROM LOOK UP REQUEST ?
1635
YES
RETURN ERROR MESSAGE TO CLIENT: FILE NOT FOUND
1640
NO
DO CHECKSUMS AND FILENAME LENGTHS MATCH ?
1645
YES
DO FILENAMES MATCH ?
1650
YES
RETURN FILE HANDLE TO CLIENT
1655
NO
NO
ACCESS NEXT GNID ON GNID-STRING
1660
END-FILE HANDLE LOOK-UP
1665

FIG. 16

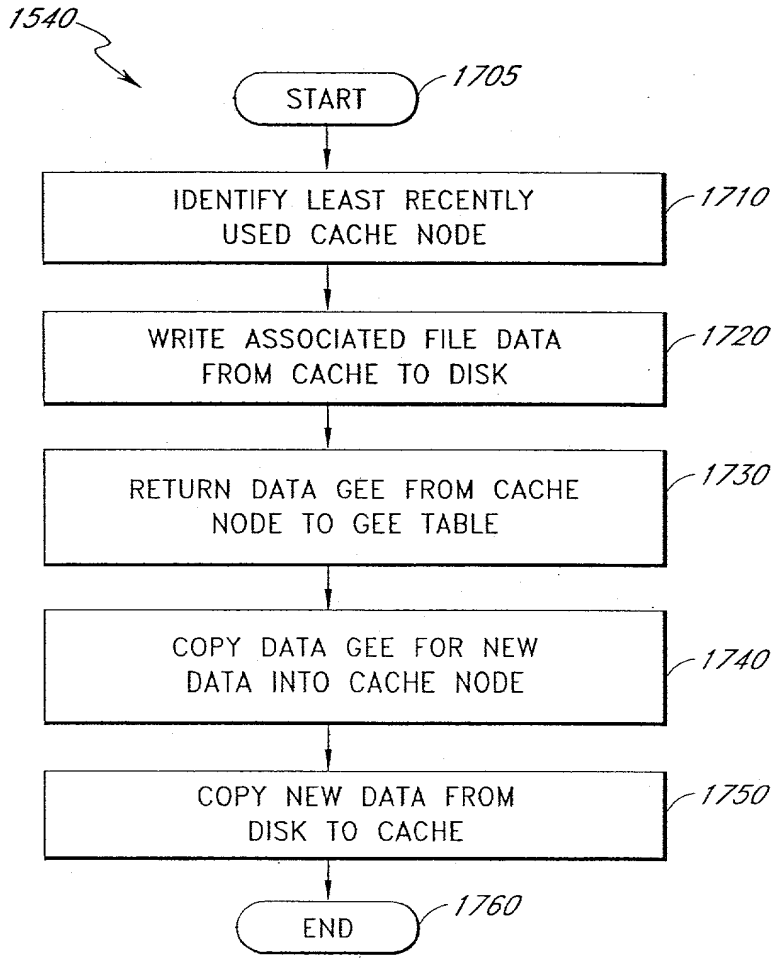

1540
START
1705
IDENTIFY LEAST RECENTLY USED CACHE NODE
1710
WRITE ASSOCIATED FILE DATA FROM CACHE TO DISK
1720
RETURN DATA GEE FROM CACHE NODE TO GEE TABLE
1730
COPY DATA GEE FOR NEW DATA INTO CACHE NODE
1740
COPY NEW DATA FROM DISK TO CACHE
1750
END
1760

FIG. 17

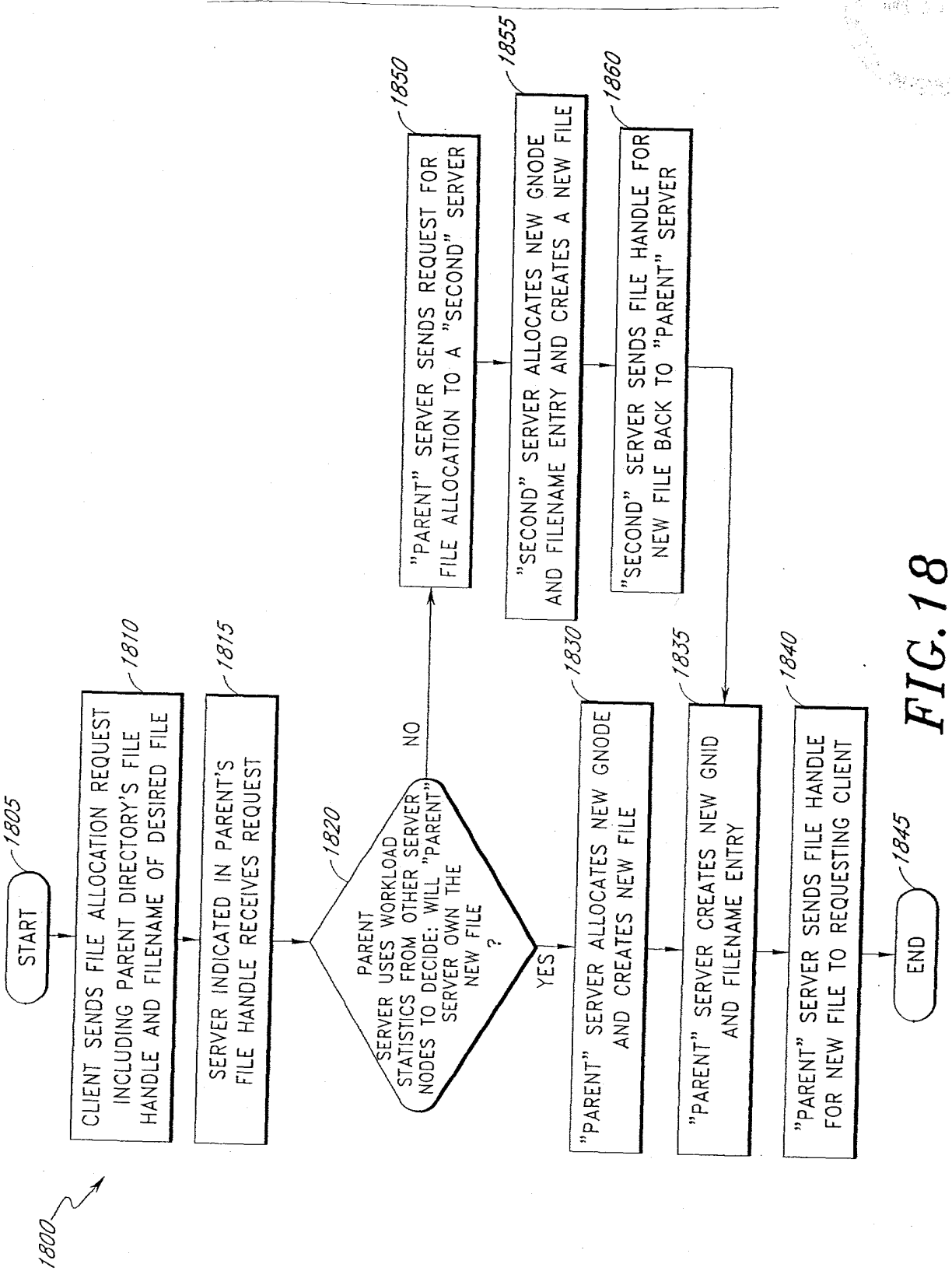

1800
START
1805
CLIENT SENDS FILE ALLOCATION REQUEST INCLUDING PARENT DIRECTORY'S FILE HANDLE AND FILENAME OF DESIRED FILE
1810
SERVER INDICATED IN PARENT'S FILE HANDLE RECEIVES REQUEST
1815
PARENT SERVER USES WORKLOAD STATISTICS FROM OTHER SERVER NODES TO DECIDE: WILL "PARENT" SERVER OWN THE NEW FILE ?
1820
NO
YES
"PARENT" SERVER SENDS REQUEST FOR FILE ALLOCATION TO A "SECOND" SERVER
1850
"SECOND" SERVER ALLOCATES NEW GNODE AND FILENAME ENTRY AND CREATES A NEW FILE
1855
"SECOND" SERVER SENDS FILE HANDLE FOR NEW FILE BACK TO "PARENT" SERVER
1860
"PARENT" SERVER ALLOCATES NEW GNODE AND CREATES NEW FILE
1830
"PARENT" SERVER CREATES NEW GNID AND FILENAME ENTRY
1835
"PARENT" SERVER SENDS FILE HANDLE FOR NEW FILE TO REQUESTING CLIENT
1840
END
1845

FIG. 18

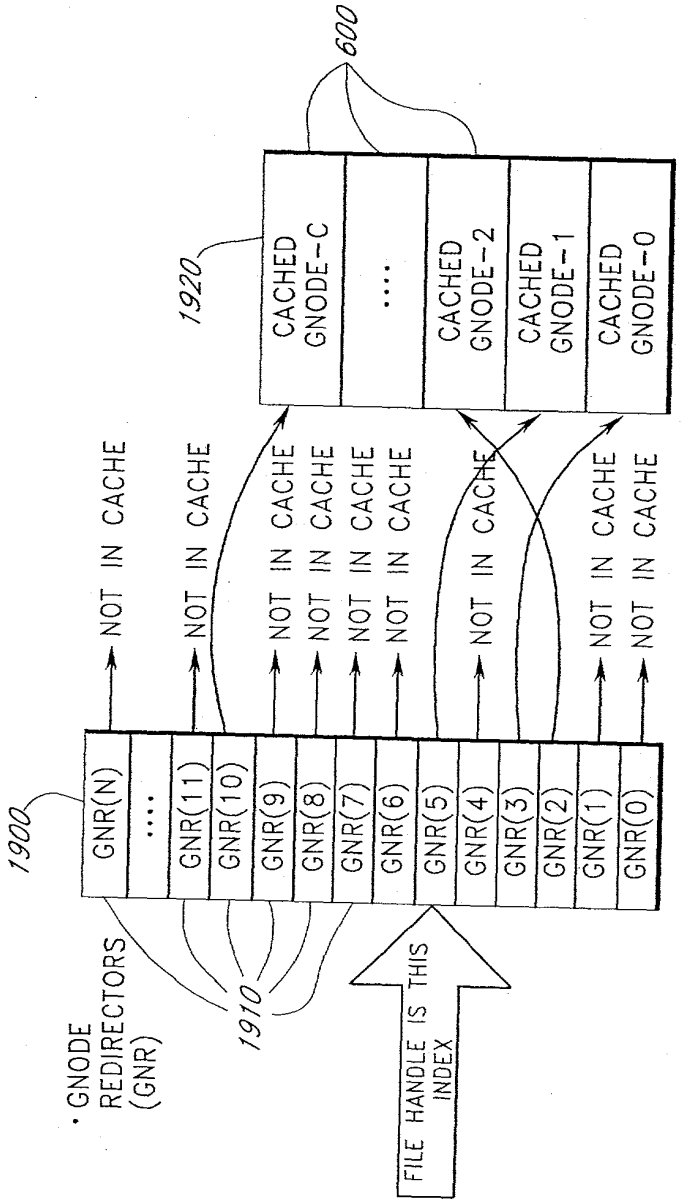

600
1920
CACHED GNODE-C
....
CACHED GNODE-2
CACHED GNODE-1
CACHED GNODE-0
NOT IN CACHE
1900
GNR(N)
....
GNR(11)
GNR(10)
GNR(9)
GNR(8)
GNR(7)
GNR(6)
GNR(5)
GNR(4)
GNR(3)
GNR(2)
GNR(1)
GNR(0)
1910
GNODE REDIRECTORS (GNR)
FILE HANDLE IS THIS INDEX

FIG. 19

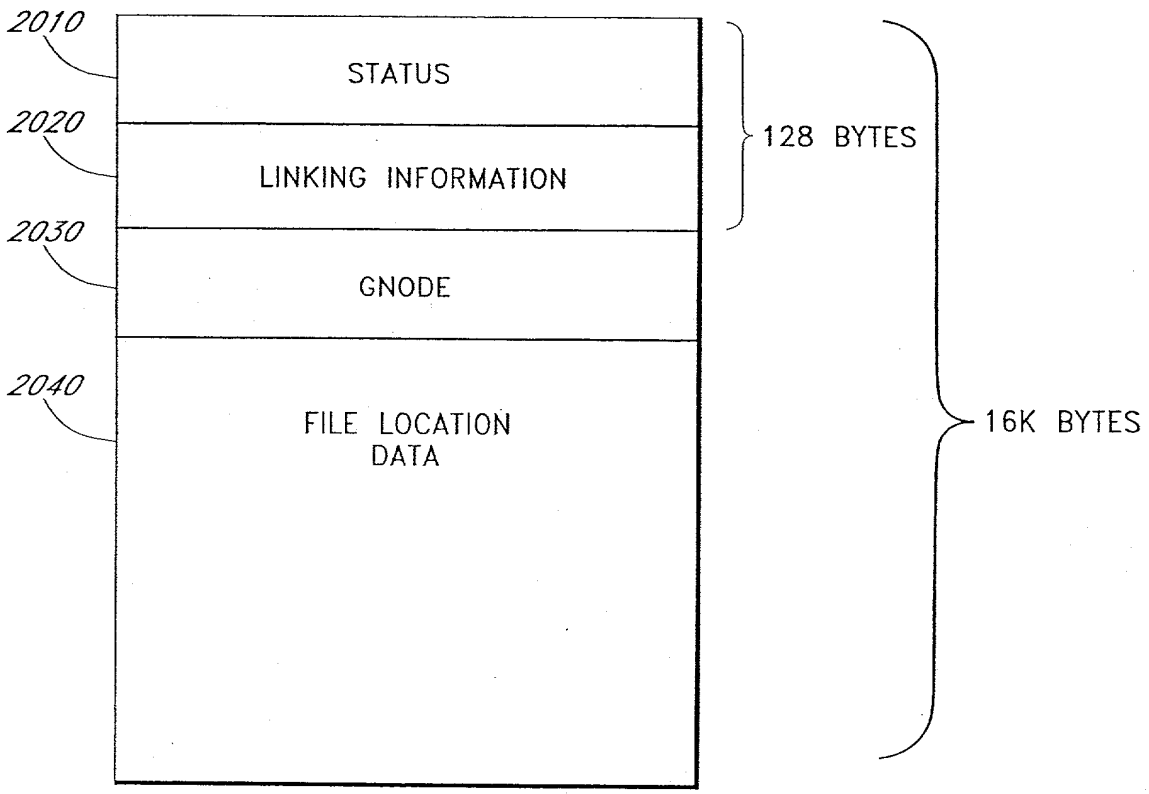

2010
STATUS
2020
LINKING INFORMATION
2030
GNODE
2040
FILE LOCATION DATA
128 BYTES
16K BYTES

FIG.20A

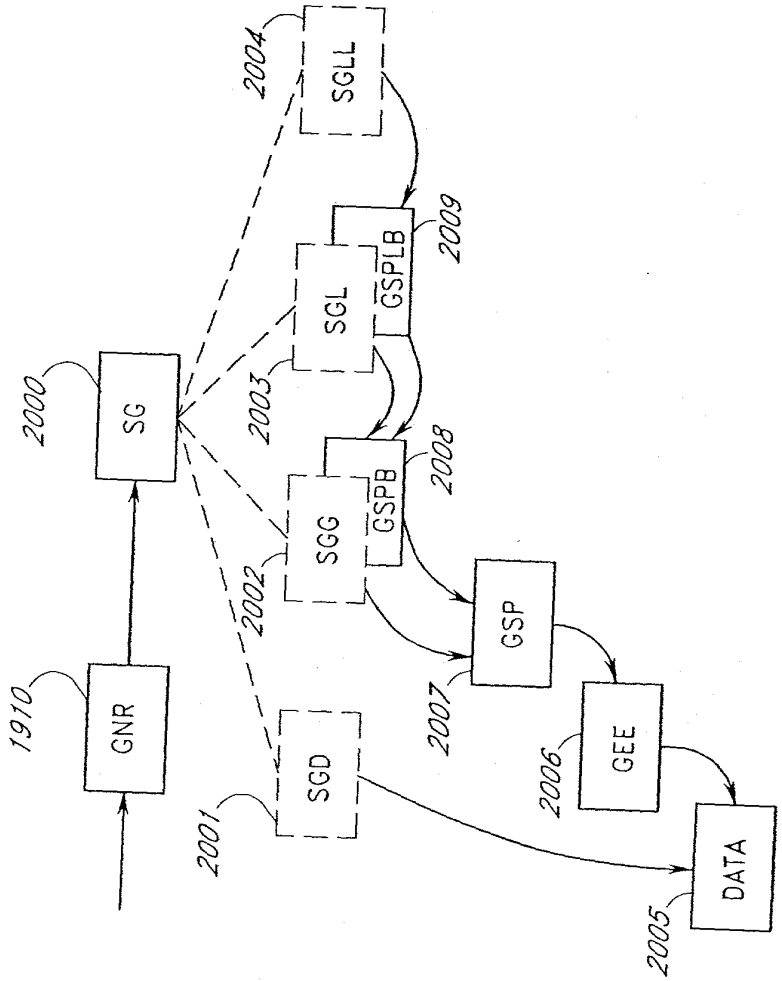

2004
SGLL
2009
GSPLB
SGL
2003
2000
SG
2008
GSPB
SGG
2002
GSP
2007
1910
GNR
SGD
2001
2006
GEE
DATA
2005

FIG. 20B

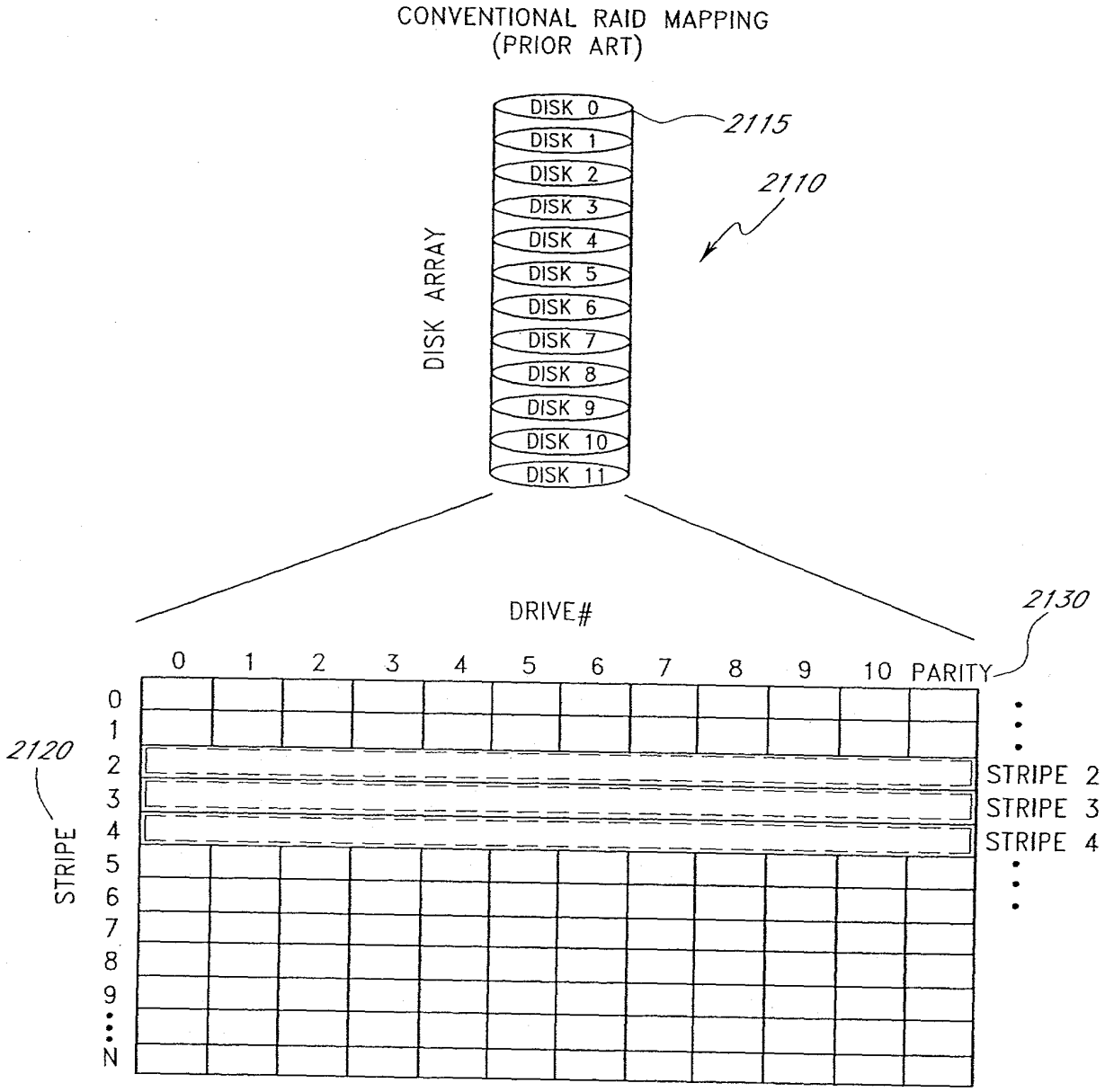

CONVENTIONAL RAID MAPPING
(PRIOR ART)
DISK 0
DISK 1
DISK 2
DISK 3
DISK 4
DISK 5
DISK 6
DISK 7
DISK 8
DISK 9
DISK 10
DISK 11
DISK ARRAY
2115
2110
DRIVE#
2130
0 1 2 3 4 5 6 7 8 9 10 PARITY
2120
STRIPE
0 1 2 3 4 5 6 7 8 9 N
STRIPE 2
STRIPE 3
STRIPE 4

FIG.21

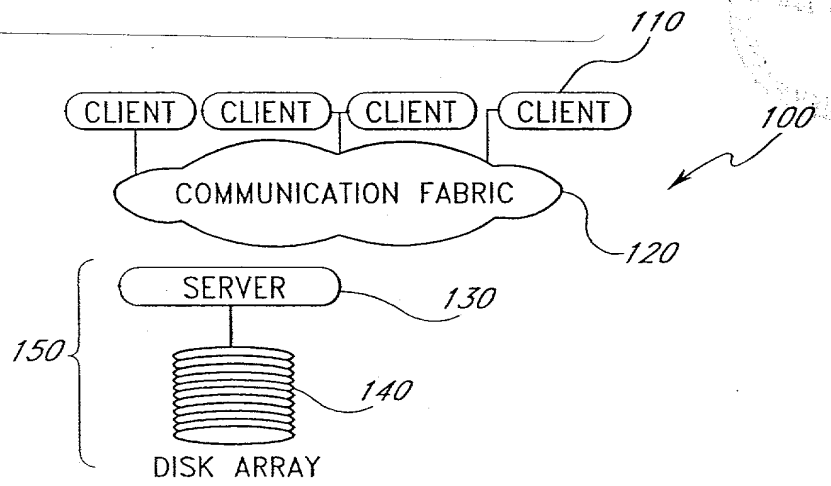


FIG. 22A

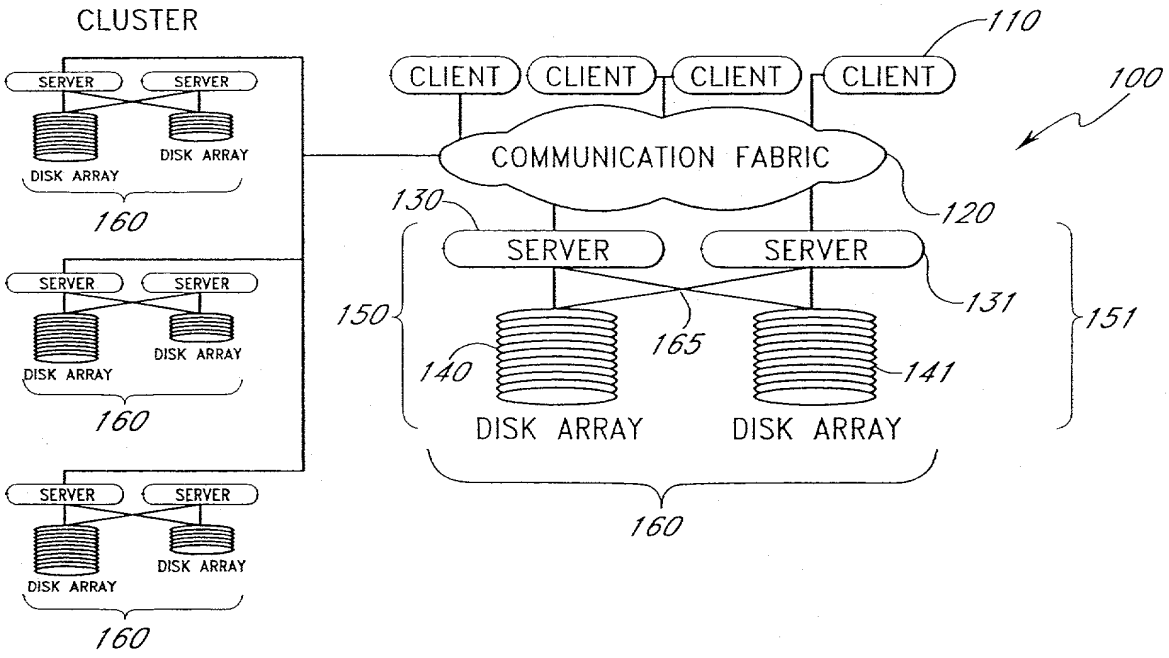


FIG. 22B

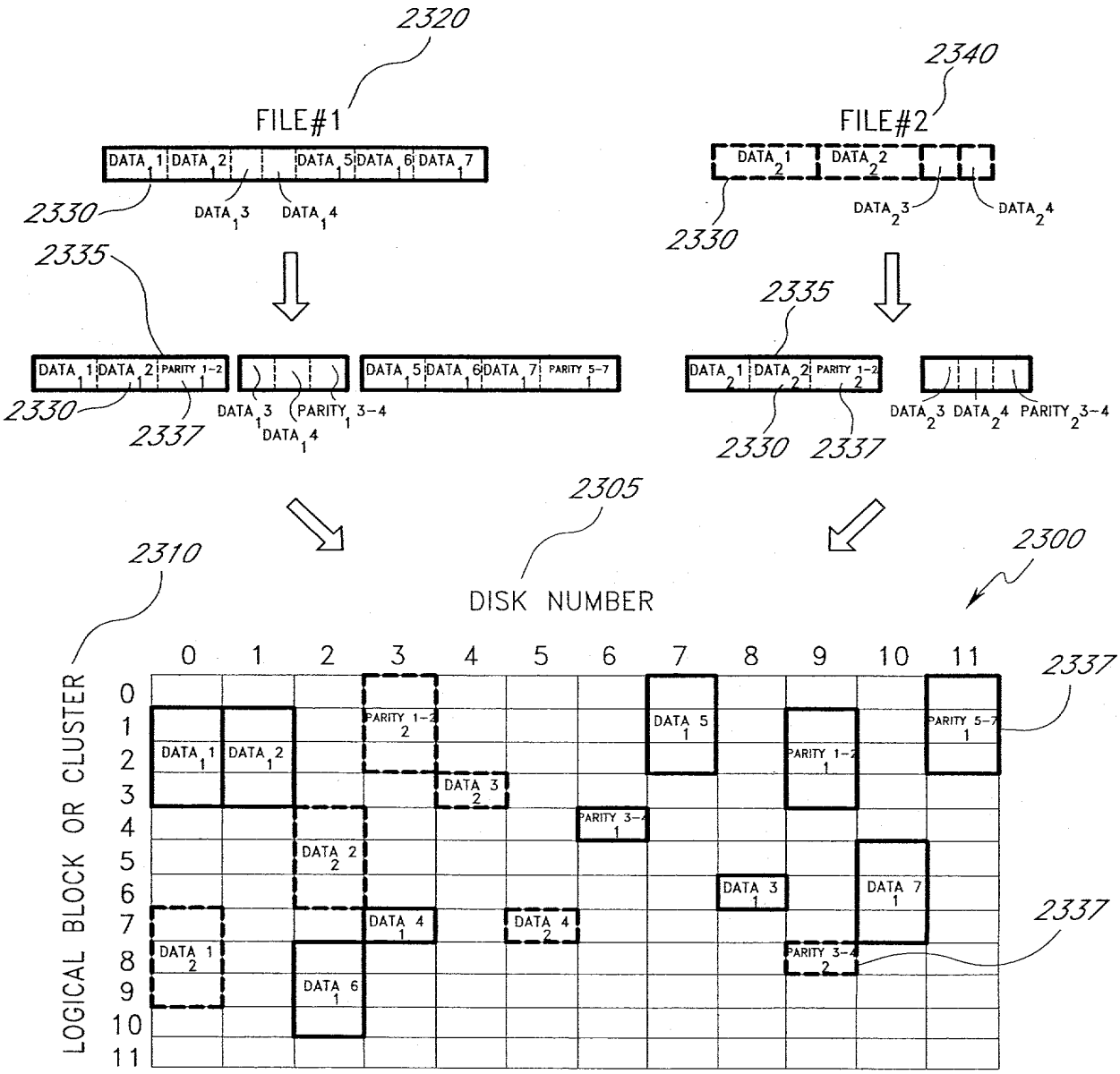

2320
FILE#1
DATA 1 DATA 2 DATA 5 DATA 6 DATA 7
DATA 1 3
DATA 1 4
2330
2335
DATA 1 DATA 2 PARITY 1-2
DATA 5 DATA 6 DATA 7 PARITY 5-7
DATA 1 3 PARITY 1 3-4
DATA 1 4
2337
2340
FILE#2
DATA 1 DATA 2
DATA 2 3
DATA 2 4
DATA 2 DATA 2 PARITY 1-2
DATA 2 3 DATA 2 4 PARITY 2 3-4
2305
DISK NUMBER
2310
2300
LOGICAL BLOCK OR CLUSTER
0 1 2 3 4 5 6 7 8 9 10 11
DATA 1 DATA 2 PARITY 1-2 DATA 3 PARITY 3-4 DATA 5 PARITY 1-2 DATA 7 PARITY 5-7
DATA 2 DATA 4 DATA 6 DATA 3 PARITY 3-4

FIG.23

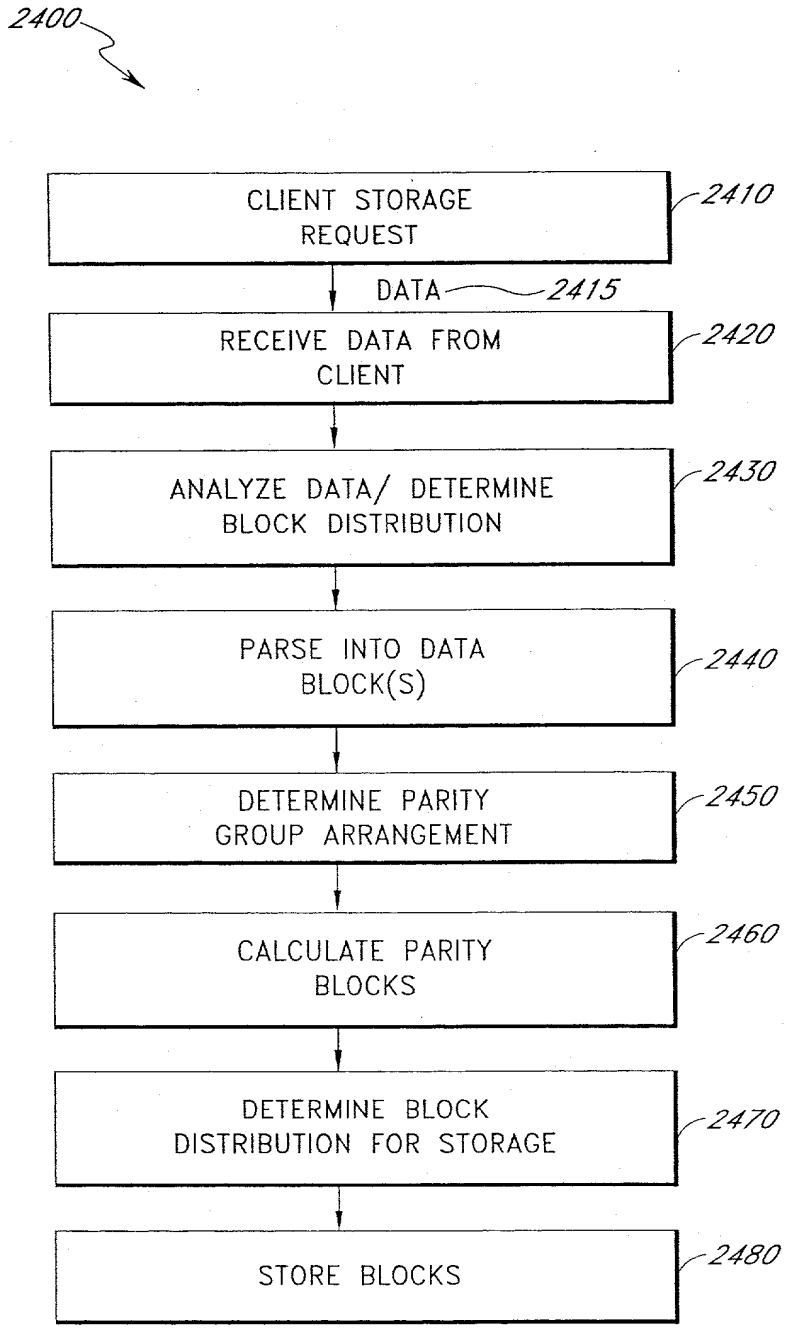

2400
CLIENT STORAGE REQUEST
2410
DATA
2415
RECEIVE DATA FROM CLIENT
2420
ANALYZE DATA/ DETERMINE BLOCK DISTRIBUTION
2430
PARSE INTO DATA BLOCK(S)
2440
DETERMINE PARITY GROUP ARRANGEMENT
2450
CALCULATE PARITY BLOCKS
2460
DETERMINE BLOCK DISTRIBUTION FOR STORAGE
2470
STORE BLOCKS
2480

FIG.24A

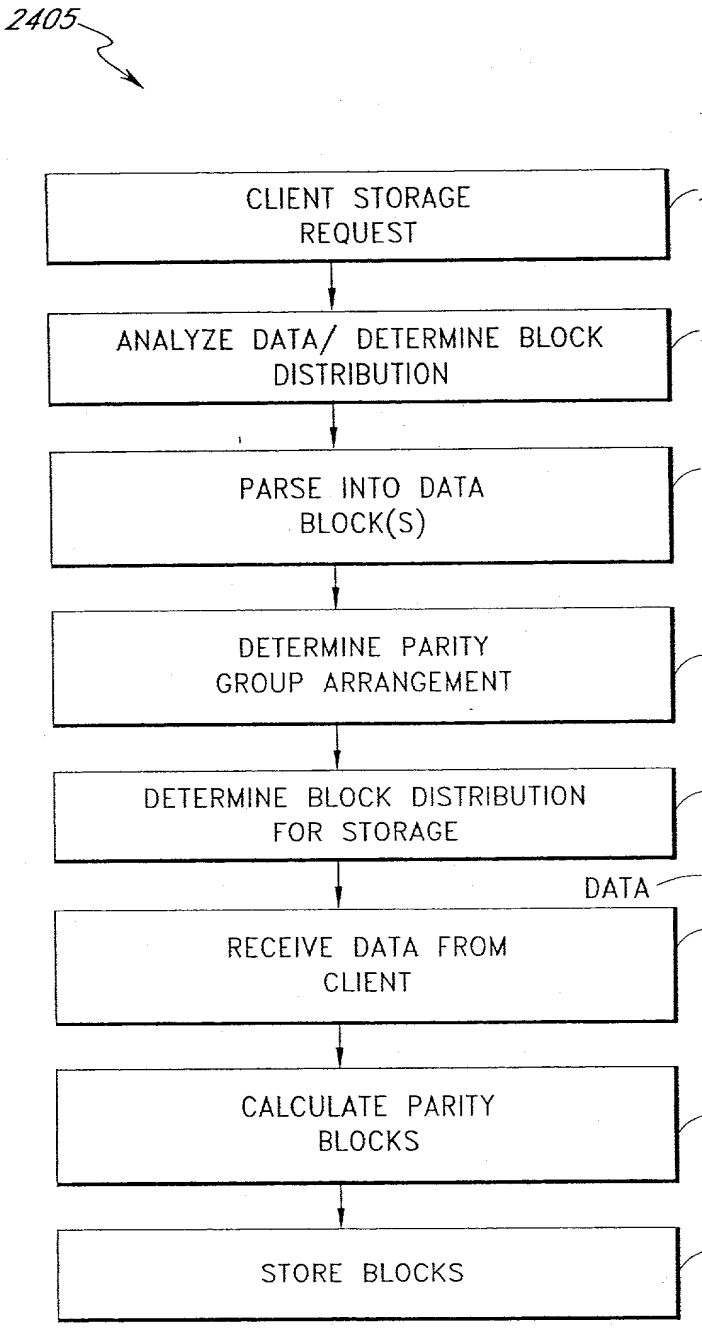

2405
CLIENT STORAGE REQUEST
2410
ANALYZE DATA/ DETERMINE BLOCK DISTRIBUTION
2430
PARSE INTO DATA BLOCK(S)
2440
DETERMINE PARITY GROUP ARRANGEMENT
2450
DETERMINE BLOCK DISTRIBUTION FOR STORAGE
2470
2415
DATA
RECEIVE DATA FROM CLIENT
2420
CALCULATE PARITY BLOCKS
2460
STORE BLOCKS
2480

FIG.24B

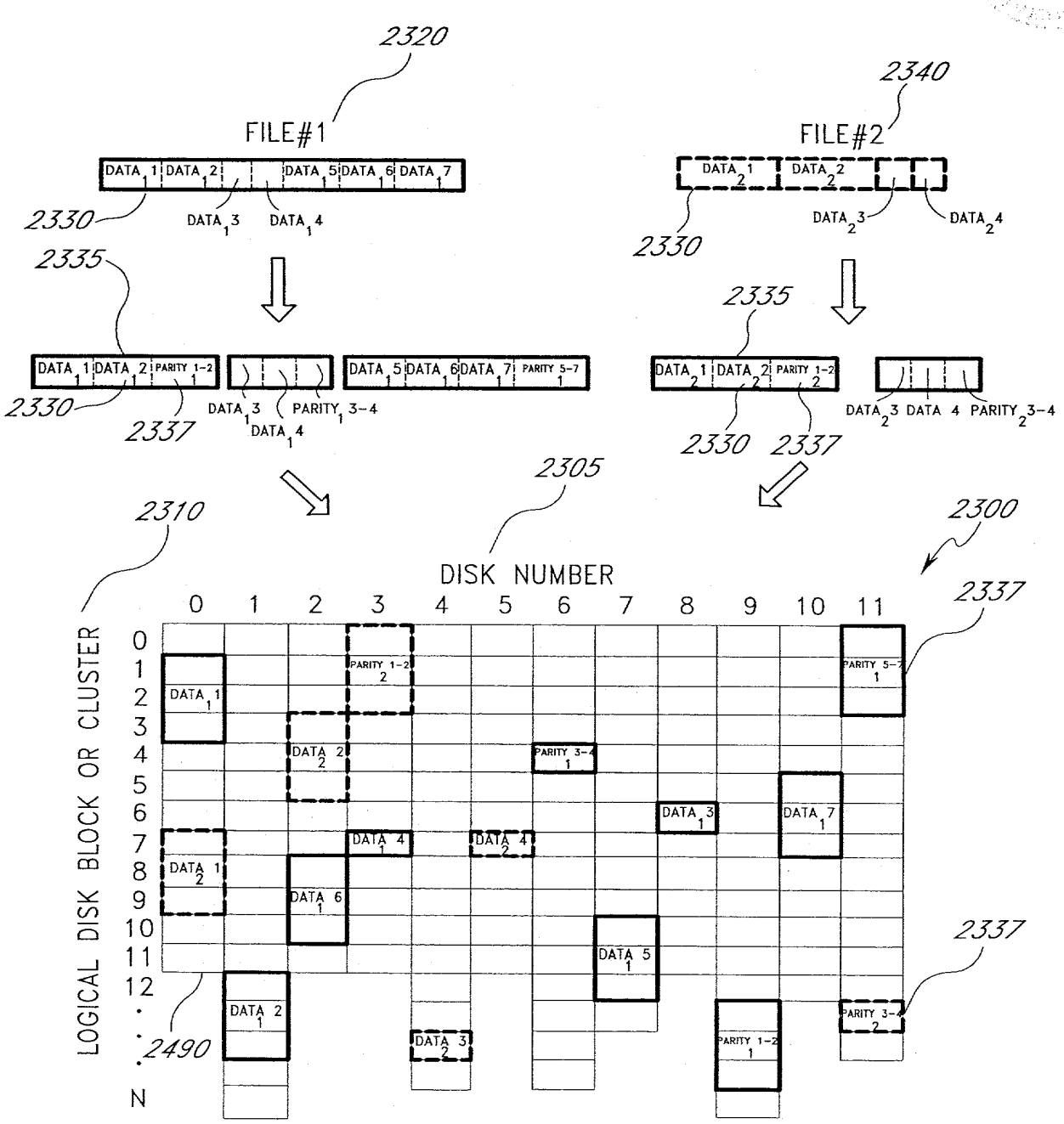

2320
FILE#1
DATA 1 DATA 2 DATA 5 DATA 6 DATA 7
2330
DATA 1 3
DATA 1 4
2335
DATA 1 DATA 2 PARITY 1-2 1
DATA 5 DATA 6 DATA 7 PARITY 5-7 1
2337
DATA 1 3
PARITY 1 3-4
DATA 1 4
2340
FILE#2
DATA 2 1 DATA 2 2
2330
DATA 2 3
DATA 2 4
2335
DATA 2 1 DATA 2 2 PARITY 1-2 2
DATA 2 3 DATA 4 PARITY 2 3-4
2330 2337
2305
2310
2300
DISK NUMBER
0 1 2 3 4 5 6 7 8 9 10 11
LOGICAL DISK BLOCK OR CLUSTER
0 1 2 3 4 5 6 7 8 9 10 11 12 N
PARITY 1-2 2
DATA 1 1
DATA 2 2
PARITY 3-4 1
DATA 3 1
DATA 7 1
DATA 4 1
DATA 4 2
DATA 2 1
DATA 6 1
DATA 5 1
PARITY 1-2 1
DATA 3 2
DATA 2 1
2490
2337
PARITY 5-7 1
2337
PARITY 3-4 2

FIG.25

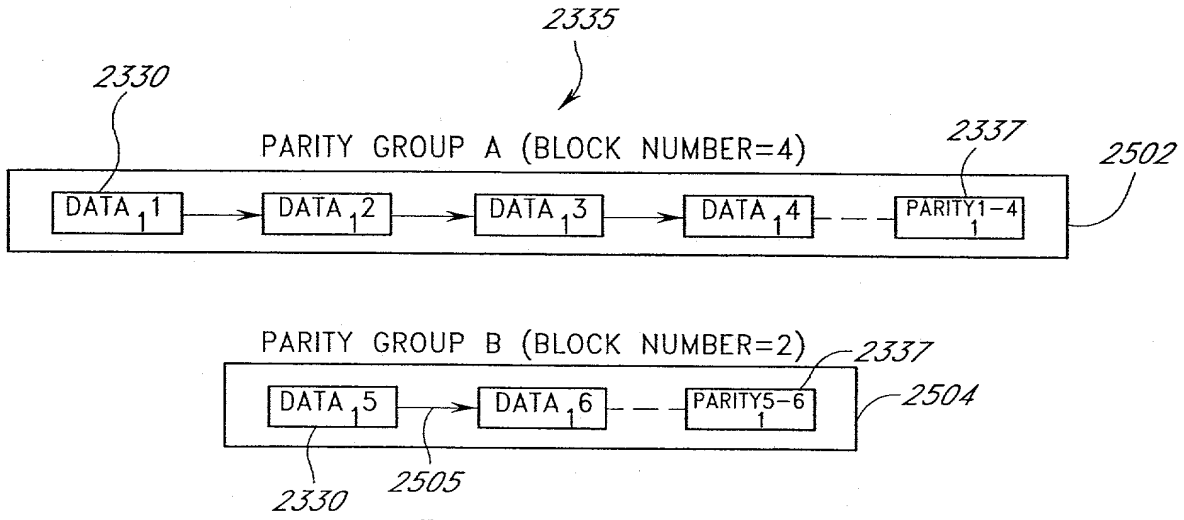


FIG.26A

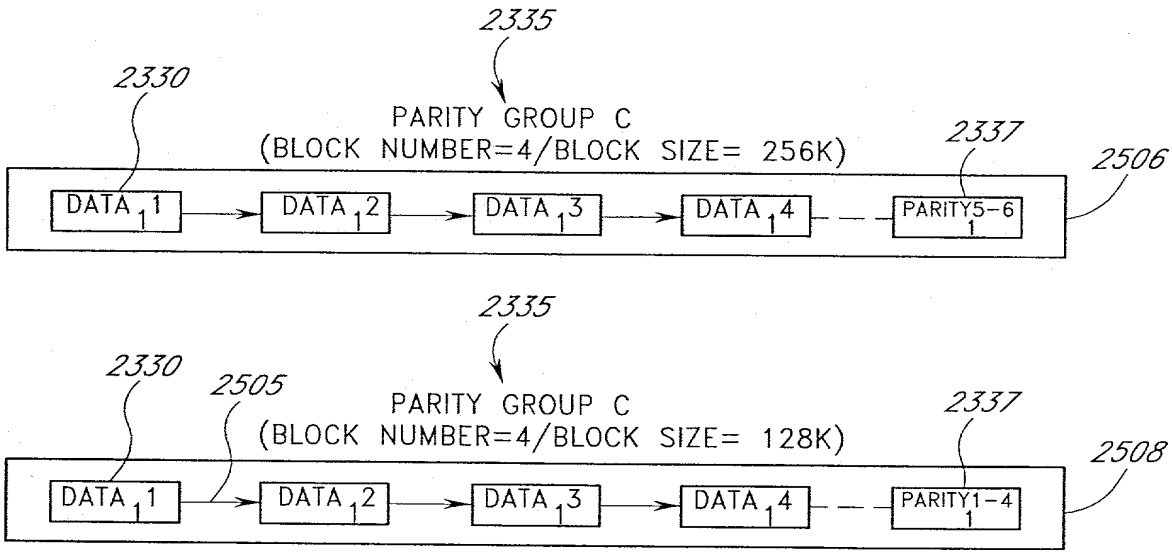


FIG.26B

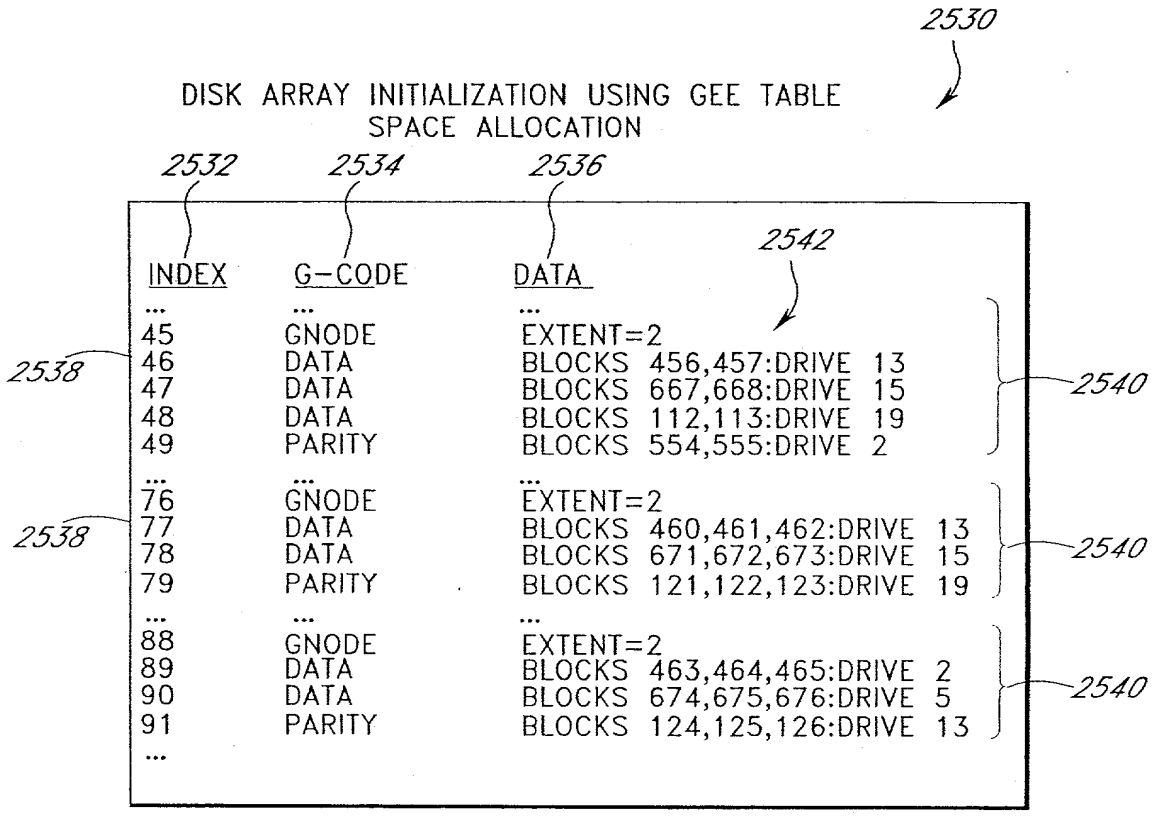
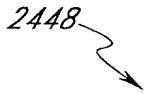

2530
DISK ARRAY INITIALIZATION USING GEE TABLE
SPACE ALLOCATION
2532
2534
2536
2542
INDEX G-CODE DATA
... ...
45 GNODE EXTENT=2
2538 46 DATA BLOCKS 456,457:DRIVE 13
47 DATA BLOCKS 667,668:DRIVE 15
48 DATA BLOCKS 112,113:DRIVE 19
49 PARITY BLOCKS 554,555:DRIVE 2
2540
... ...
76 GNODE EXTENT=2
2538 77 DATA BLOCKS 460,461,462:DRIVE 13
78 DATA BLOCKS 671,672,673:DRIVE 15
79 PARITY BLOCKS 121,122,123:DRIVE 19
2540
... ...
88 GNODE EXTENT=2
89 DATA BLOCKS 463,464,465:DRIVE 2
90 DATA BLOCKS 674,675,676:DRIVE 5
91 PARITY BLOCKS 124,125,126:DRIVE 13
2540
...

FIG. 27



ARRAY PREPARATION/ G-TABLE FORMATTING

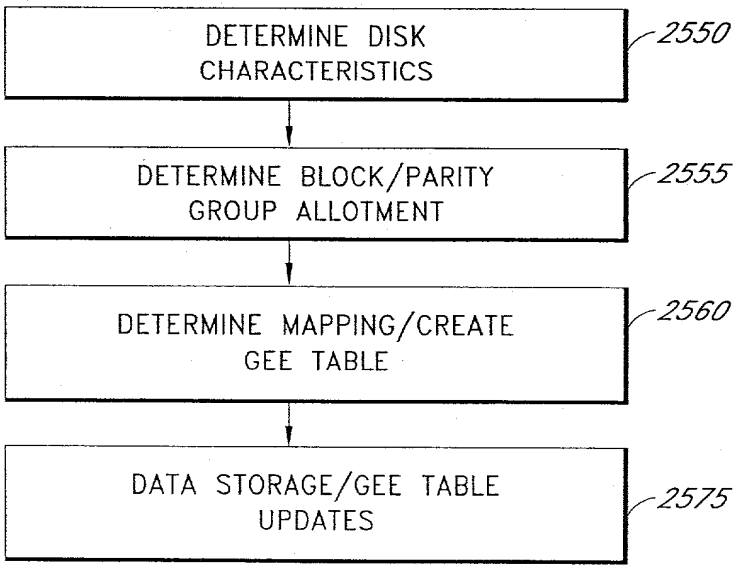


FIG.28

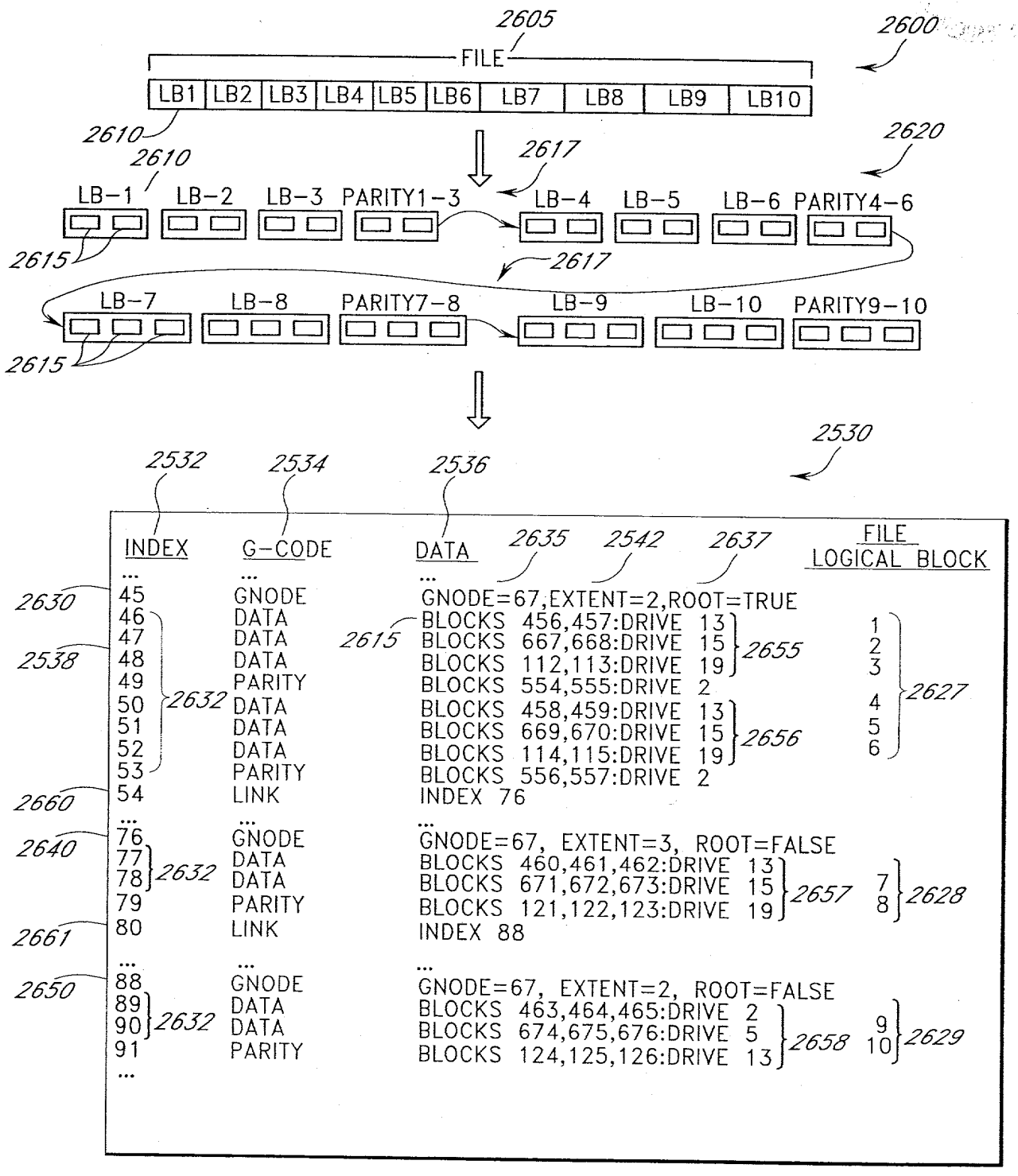

2605
2600
FILE
LB1 LB2 LB3 LB4 LB5 LB6 LB7 LB8 LB9 LB10
2610
2610
2617
2620
LB-1 LB-2 LB-3 PARITY1-3 LB-4 LB-5 LB-6 PARITY4-6
2615
2617
LB-7 LB-8 PARITY7-8 LB-9 LB-10 PARITY9-10
2615
2530
2532
2534
2536
2635
2542
2637
INDEX
G-CODE
DATA
FILE LOGICAL BLOCK
2630
2538
2632
2660
2640
2632
2661
2650
2632
2615
2655
2656
2627
2657
2628
2658
2629
45 GNODE GNODE=67,EXTENT=2,ROOT=TRUE
46 DATA BLOCKS 456,457:DRIVE 13 1
47 DATA BLOCKS 667,668:DRIVE 15 2
48 DATA BLOCKS 112,113:DRIVE 19 3
49 PARITY BLOCKS 554,555:DRIVE 2
50 DATA BLOCKS 458,459:DRIVE 13 4
51 DATA BLOCKS 669,670:DRIVE 15 5
52 DATA BLOCKS 114,115:DRIVE 19 6
53 PARITY BLOCKS 556,557:DRIVE 2
54 LINK INDEX 76
76 GNODE GNODE=67, EXTENT=3, ROOT=FALSE
77 DATA BLOCKS 460,461,462:DRIVE 13 7
78 DATA BLOCKS 671,672,673:DRIVE 15 8
79 PARITY BLOCKS 121,122,123:DRIVE 19
80 LINK INDEX 88
88 GNODE GNODE=67, EXTENT=2, ROOT=FALSE
89 DATA BLOCKS 463,464,465:DRIVE 2 9
90 DATA BLOCKS 674,675,676:DRIVE 5 10
91 PARITY BLOCKS 124,125,126:DRIVE 13

FIG. 29

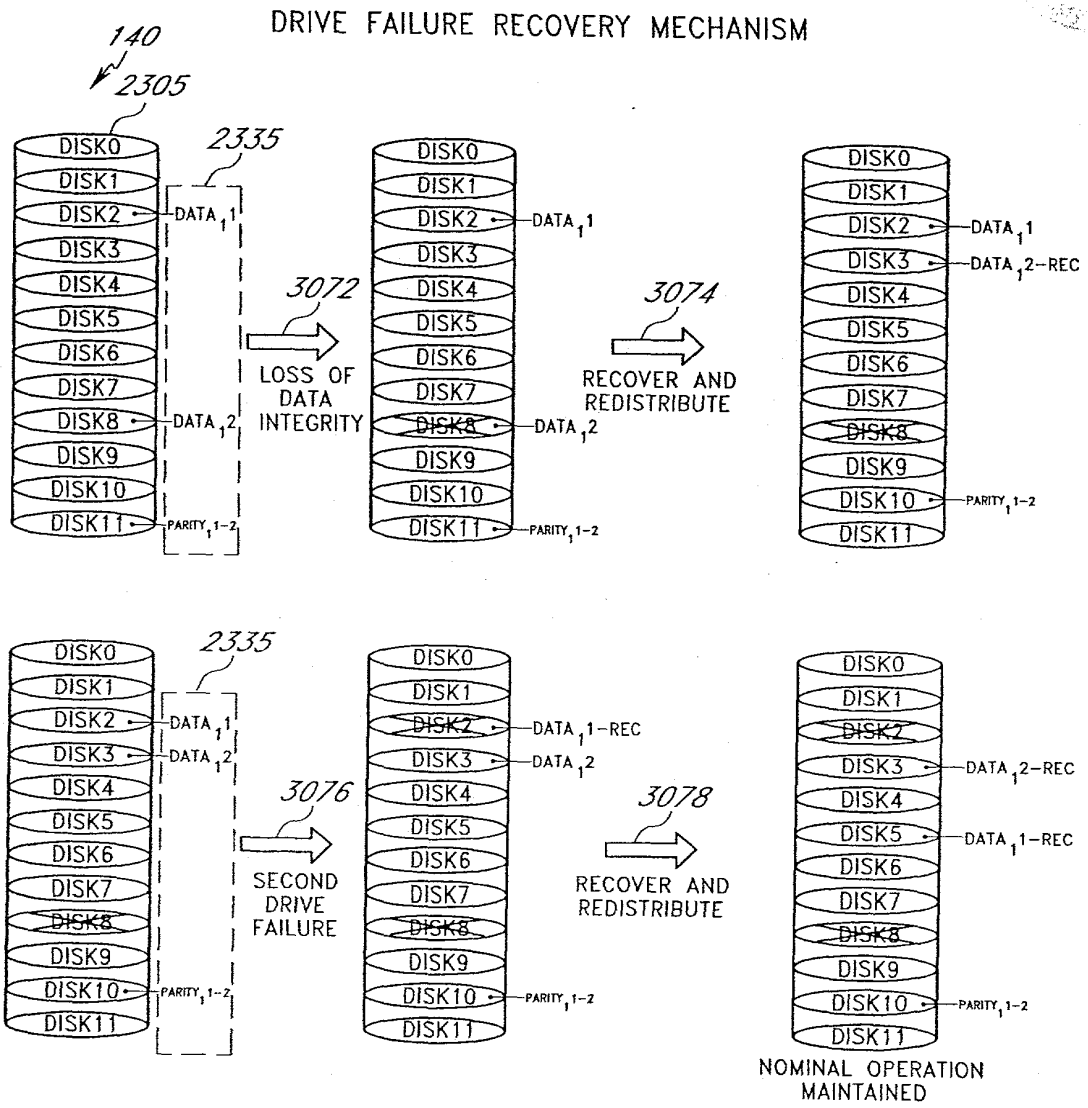
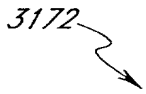

DRIVE FAILURE RECOVERY MECHANISM
140
2305
2335
DISK0
DISK1
DISK2
DISK3
DISK4
DISK5
DISK6
DISK7
DISK8
DISK9
DISK10
DISK11
DATA 1 1
DATA 1 2
PARITY 1 1-2
3072
LOSS OF DATA INTEGRITY
3074
RECOVER AND REDISTRIBUTE
DATA 1 2-REC
3076
SECOND DRIVE FAILURE
3078
RECOVER AND REDISTRIBUTE
DATA 1 1-REC
NOMINAL OPERATION MAINTAINED

FIG. 30



DATA RECOVERY PROCESS

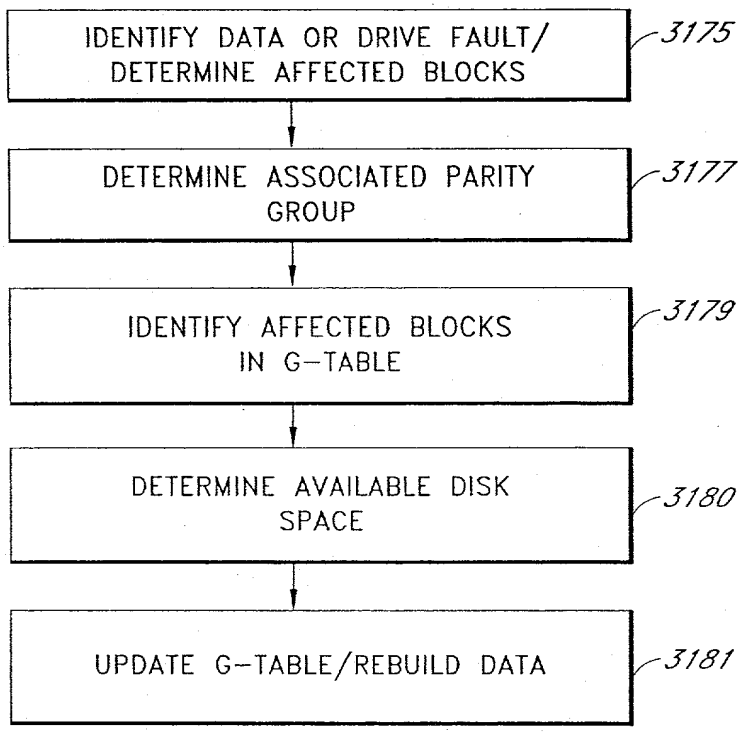


FIG.31

FIG. 32A

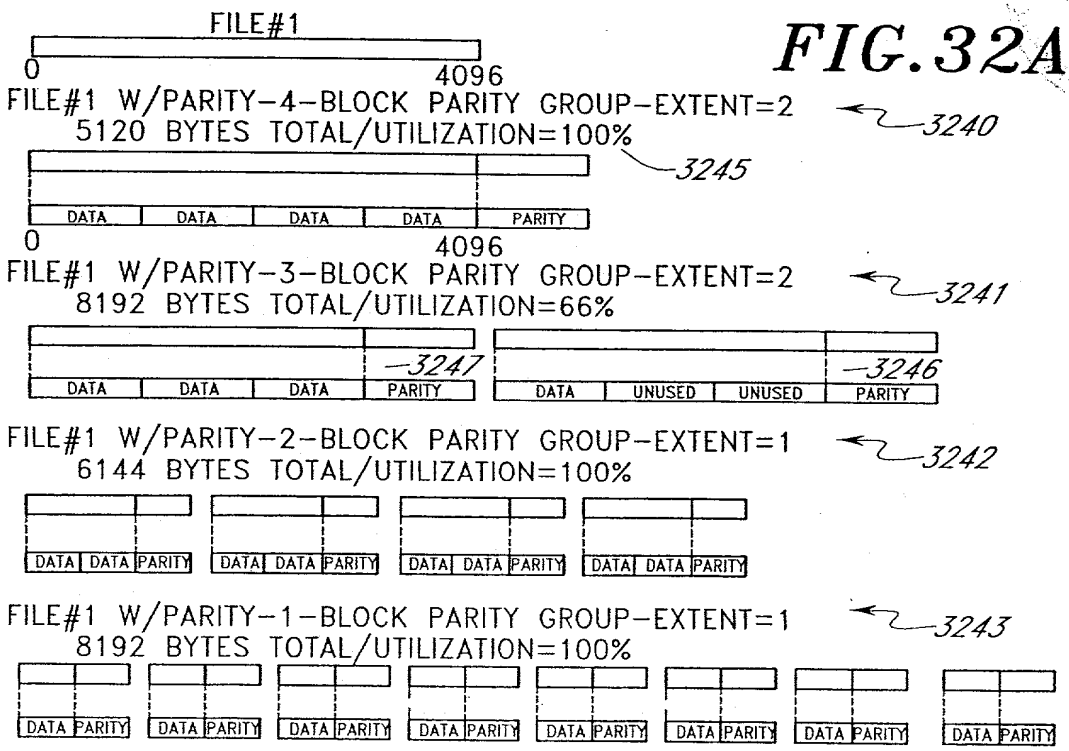
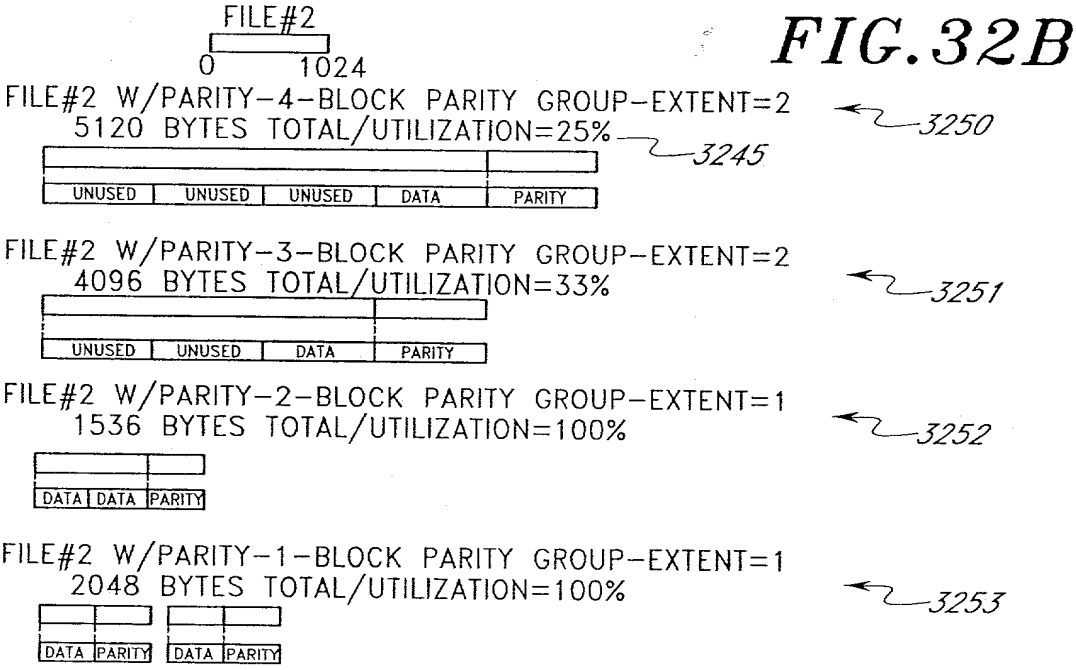


FIG. 32B



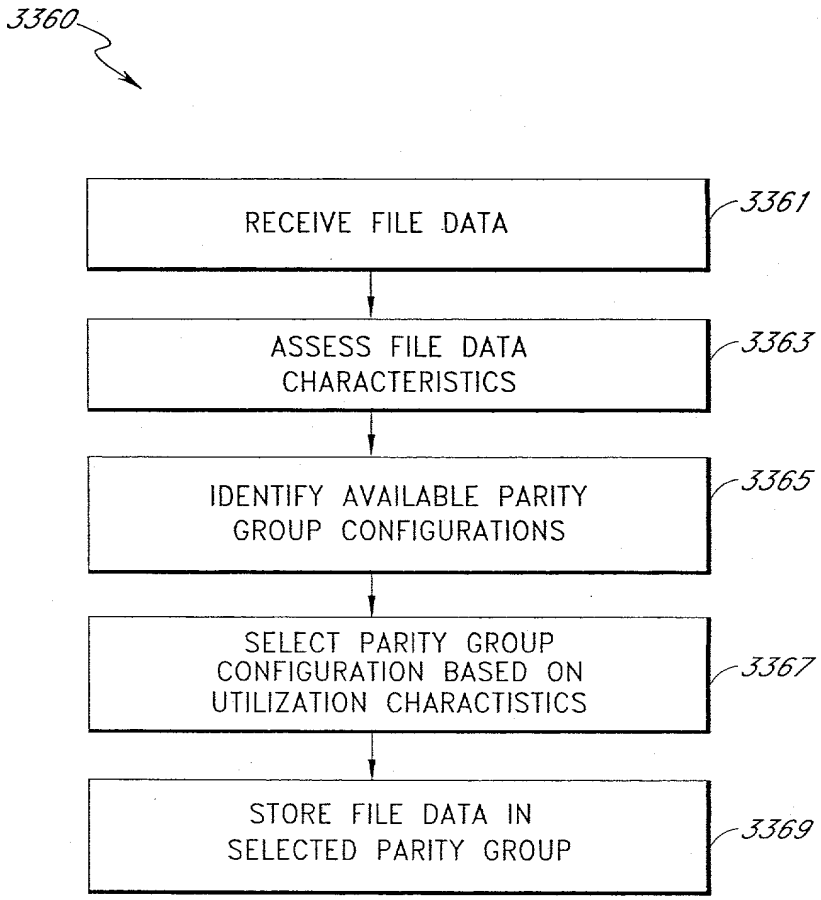

3360
RECEIVE FILE DATA
3361
ASSESS FILE DATA CHARACTERISTICS
3363
IDENTIFY AVAILABLE PARITY GROUP CONFIGURATIONS
3365
SELECT PARITY GROUP CONFIGURATION BASED ON UTILIZATION CHARACTISTICS
3367
STORE FILE DATA IN SELECTED PARITY GROUP
3369

FIG.33

FIG.34A

		INTIAL ALLOCATION 3491	DISK SPACE% 3485
DATA DATA DATA DATA PARITY	4 BLOCK PANITY 3480	10000 GROUPS	36%
DATA DATA DATA PARITY	3 BLOCK PANITY 3481	10000 GROUPS	28%
DATA DATA PARITY	2 BLOCK PANITY 3482	10000 GROUPS	22%
DATA PARITY	1 BLOCK PANITY 3483	10000 GROUPS	14%

DISK USAGE 3487

FIG.34B

		FREE 3492	OCCUPIED 3490	TOTAL	DISK SPACE%
3480	4 BLOCK PANITY	2500 GROUPS	7500 GROUPS	10000 GROUPS	36%
3481	3 BLOCK PANITY	7500 GROUPS	2500 GROUPS	10000 GROUPS	28%
3482	2 BLOCK PANITY	3500 GROUPS	6500 GROUPS	10000 GROUPS	22%
3483	1 BLOCK PANITY	500 GROUPS	9500 GROUPS	10000 GROUPS	14%

REDISTRIBUTION 3494

FIG.34C

			FREE 3492	OCCUPIED 3490	TOTAL	DISK SPACE%
3480	4 BLOCK PANITY		2500 GROUPS	7500 GROUPS	10000 GROUPS	36%
3481	3 BLOCK PANITY	-5000 GROUPS OF 3 BLOCK PARITY	2500 groups	2500 GROUPS	5000 GROUPS	14%
3482	2 BLOCK PANITY	+10000 GROUPS OF 1 BLOCK PARITY	3500 GROUPS	6500 GROUPS	10000 GROUPS	22%
3483	1 BLOCK PANITY		10500 GROUPS	9500 GROUPS	20000 GROUPS	28%

REDISTRIBUTION

PARITY GROUP REDISTRIBUTION PROCESSES 3500

FIG.35A

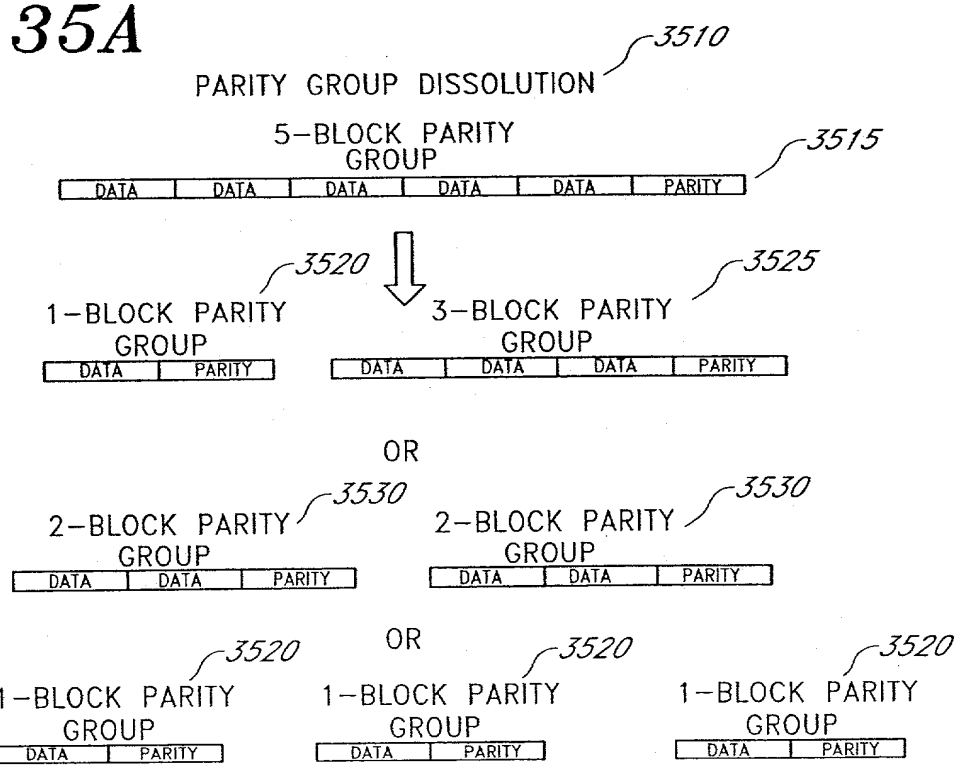
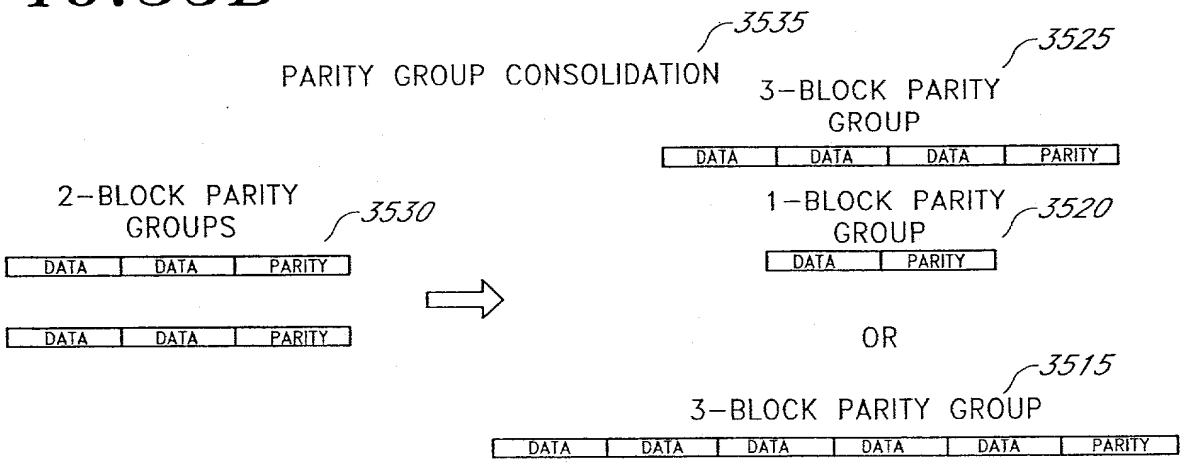


FIG.35B



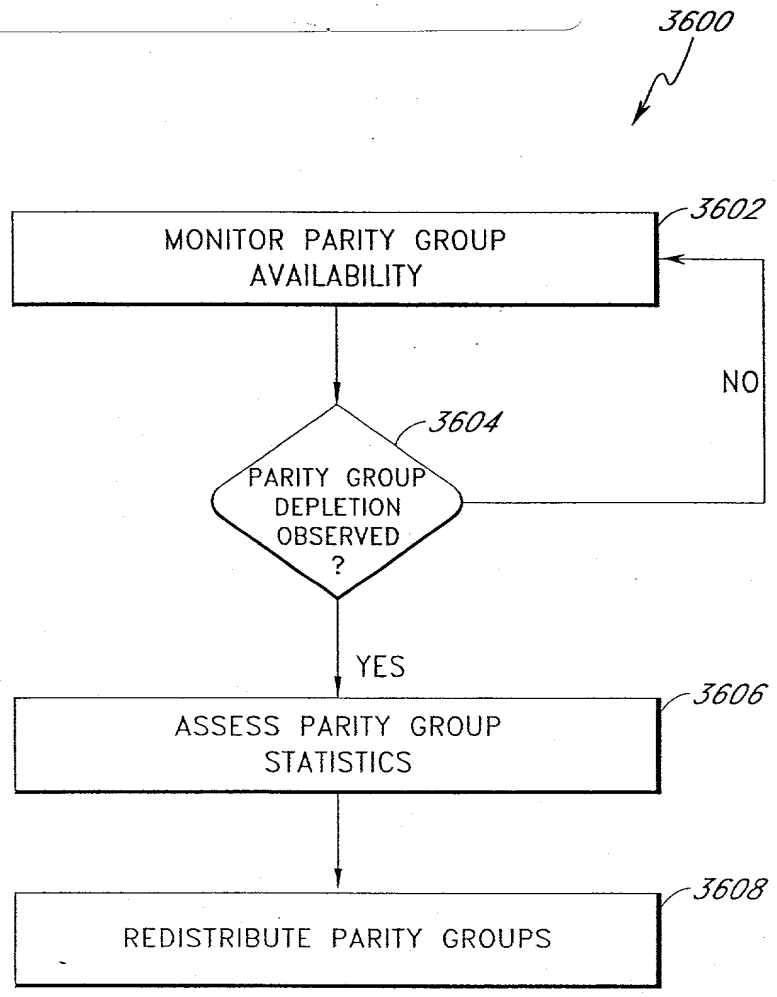

3600
MONITOR PARITY GROUP AVAILABILITY
3602
NO
3604
PARITY GROUP DEPLETION OBSERVED ?
YES
ASSESS PARITY GROUP STATISTICS
3606
REDISTRIBUTE PARITY GROUPS
3608

FIG.36

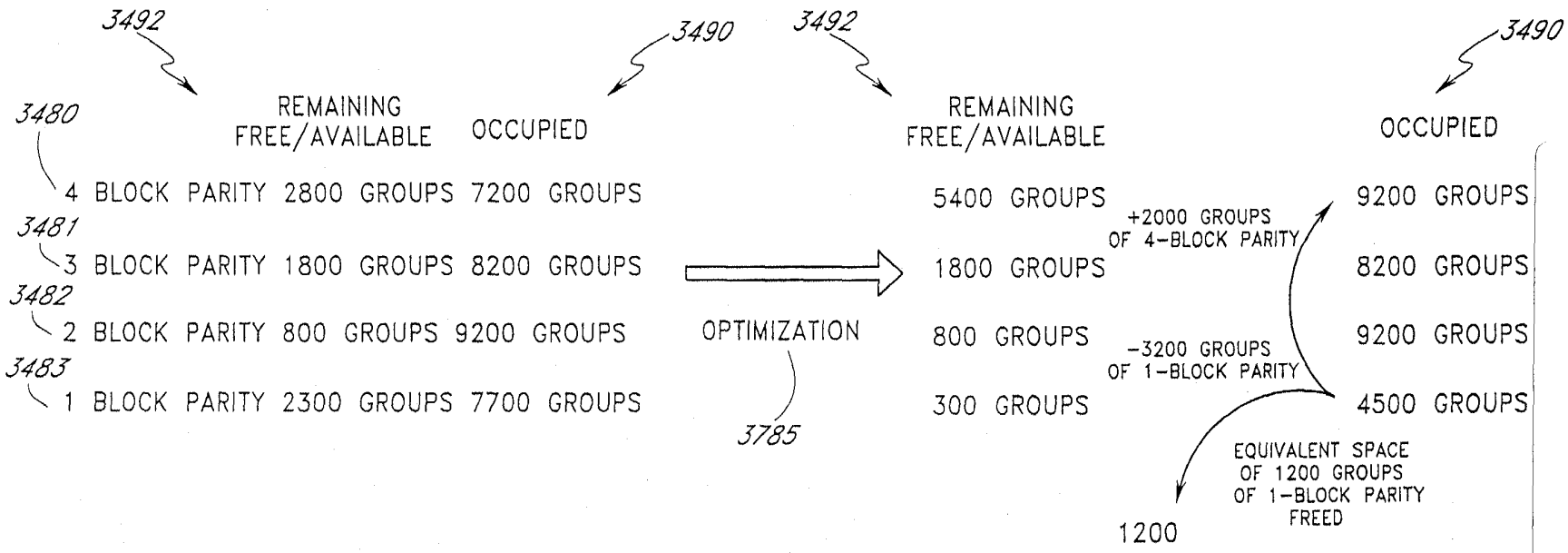

3492
3490
3492
3490
3480
REMAINING FREE/AVAILABLE
OCCUPIED
REMAINING FREE/AVAILABLE
OCCUPIED
4 BLOCK PARITY 2800 GROUPS 7200 GROUPS
3481
3 BLOCK PARITY 1800 GROUPS 8200 GROUPS
3482
2 BLOCK PARITY 800 GROUPS 9200 GROUPS
3483
1 BLOCK PARITY 2300 GROUPS 7700 GROUPS
OPTIMIZATION
3785
5400 GROUPS
1800 GROUPS
800 GROUPS
300 GROUPS
+2000 GROUPS OF 4-BLOCK PARITY
-3200 GROUPS OF 1-BLOCK PARITY
9200 GROUPS
8200 GROUPS
9200 GROUPS
4500 GROUPS
EQUIVALENT SPACE OF 1200 GROUPS OF 1-BLOCK PARITY FREED
1200

FIG.37

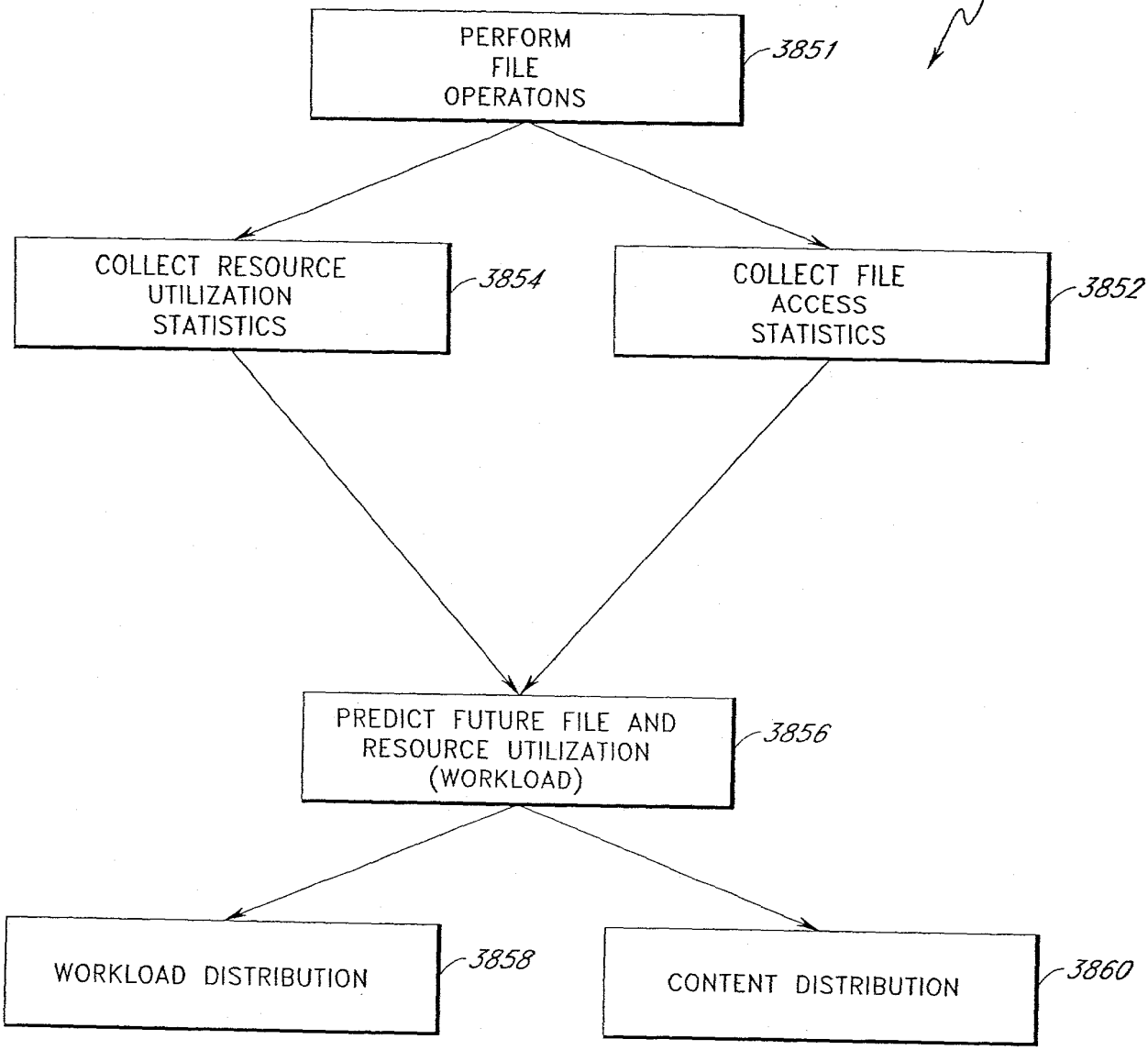

3800
PERFORM FILE OPERATONS
3851
COLLECT RESOURCE UTILIZATION STATISTICS
3854
COLLECT FILE ACCESS STATISTICS
3852
PREDICT FUTURE FILE AND RESOURCE UTILIZATION (WORKLOAD)
3856
WORKLOAD DISTRIBUTION
3858
CONTENT DISTRIBUTION
3860

FIG. 38

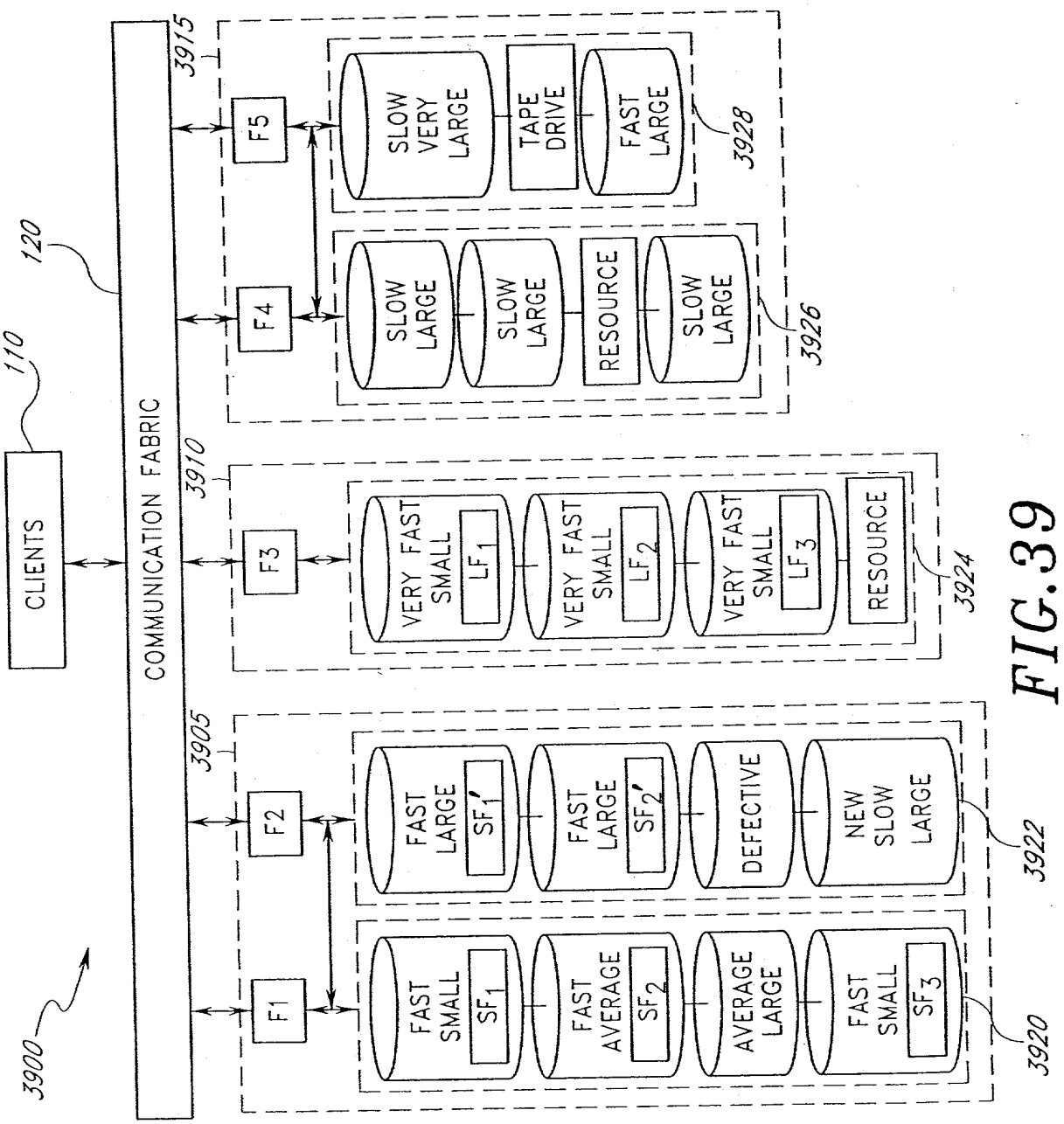

3900
CLIENTS
110
COMMUNICATION FABRIC
120
F1
F2
F3
F4
F5
3905
3910
3915
FAST SMALL SF1
FAST AVERAGE SF2
AVERAGE LARGE
FAST SMALL SF3
3920
FAST LARGE SF1'
FAST LARGE SF2'
DEFECTIVE
NEW SLOW LARGE
3922
VERY FAST SMALL LF1
VERY FAST SMALL LF2
VERY FAST SMALL LF3
RESOURCE
3924
SLOW LARGE
SLOW LARGE
RESOURCE
SLOW LARGE
3926
SLOW VERY LARGE
TAPE DRIVE
FAST LARGE
3928

FIG. 39

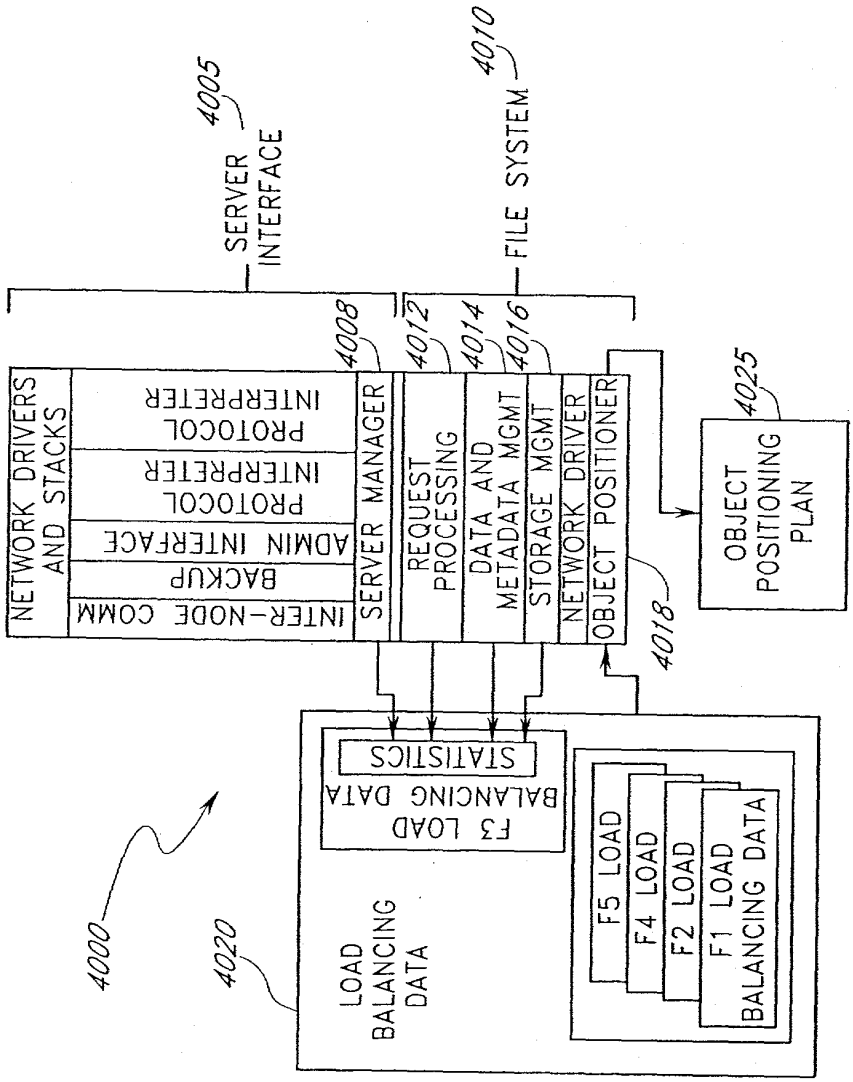

4005
SERVER INTERFACE
4010
FILE SYSTEM
4008
4012
4014
4016
NETWORK DRIVERS AND STACKS
INTER-NODE COMM
BACKUP
ADMIN INTERFACE
PROTOCOL INTERPRETER
PROTOCOL INTERPRETER
SERVER MANAGER
REQUEST PROCESSING
DATA AND METADATA MGMT
STORAGE MGMT
NETWORK DRIVER
OBJECT POSITIONER
4018
4025
OBJECT POSITIONING PLAN
4000
4020
LOAD BALANCING DATA
F3 LOAD BALANCING DATA
STATISTICS
F5 LOAD
F4 LOAD
F2 LOAD
F1 LOAD BALANCING DATA

FIG. 40

F3 OBJECT
POSITIONING PLAN

4025

- PUSH LF TO F4–F5 CLUSTER
- ISSUE FILE HANDLE FOR LF=STALE
- IF REQUESTED,
  - SEND ACCEPTANCE FOR COPY OF SF TO F1
  - CREATE COPY OF SF
  - SEND FILE HANDLE OF SF TO F1

FIG. 41

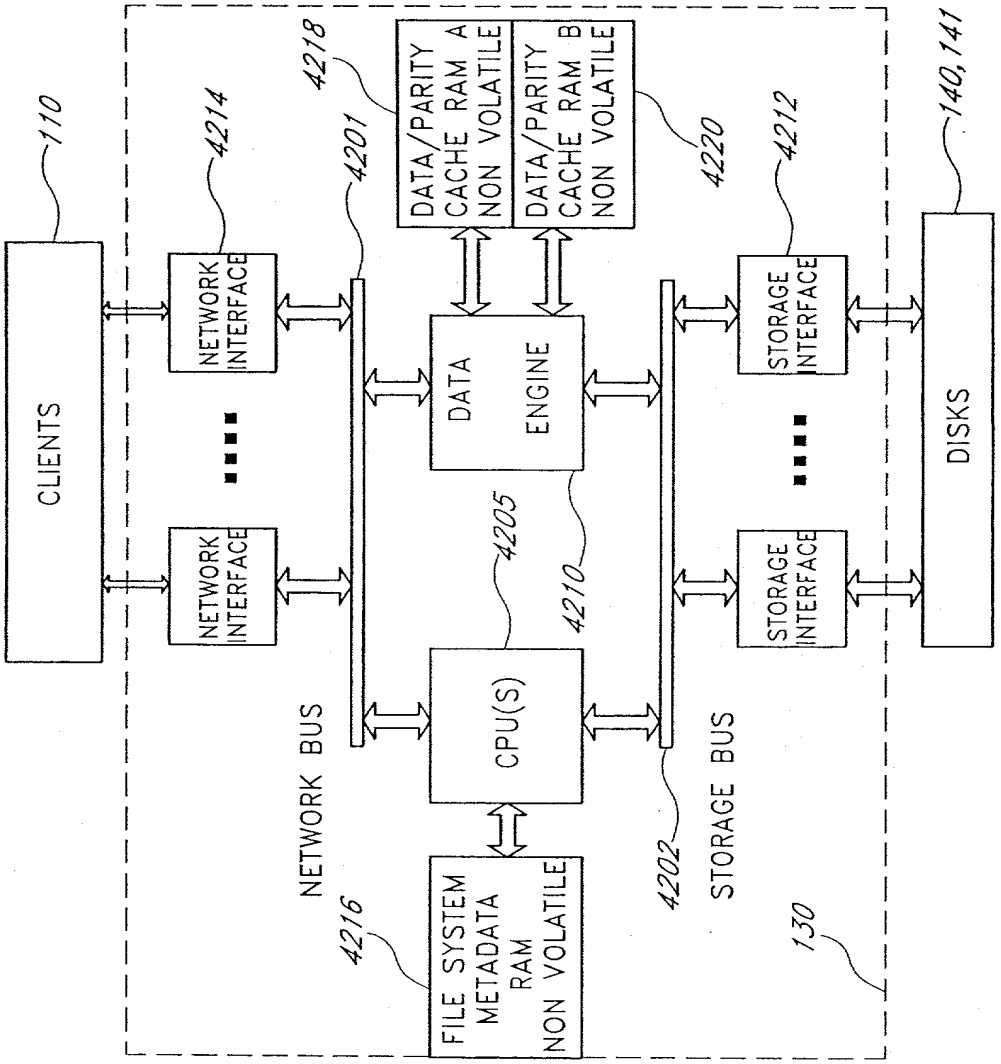

110
CLIENTS
4214
NETWORK INTERFACE
NETWORK INTERFACE
4218
4201
DATA/PARITY CACHE RAM A NON VOLATILE
DATA/PARITY CACHE RAM B NON VOLATILE
4220
DATA ENGINE
4205
4210
CPU(S)
4216
FILE SYSTEM METADATA RAM NON VOLATILE
NETWORK BUS
4202
STORAGE BUS
130
4212
STORAGE INTERFACE
STORAGE INTERFACE
140, 141
DISKS

FIG. 42

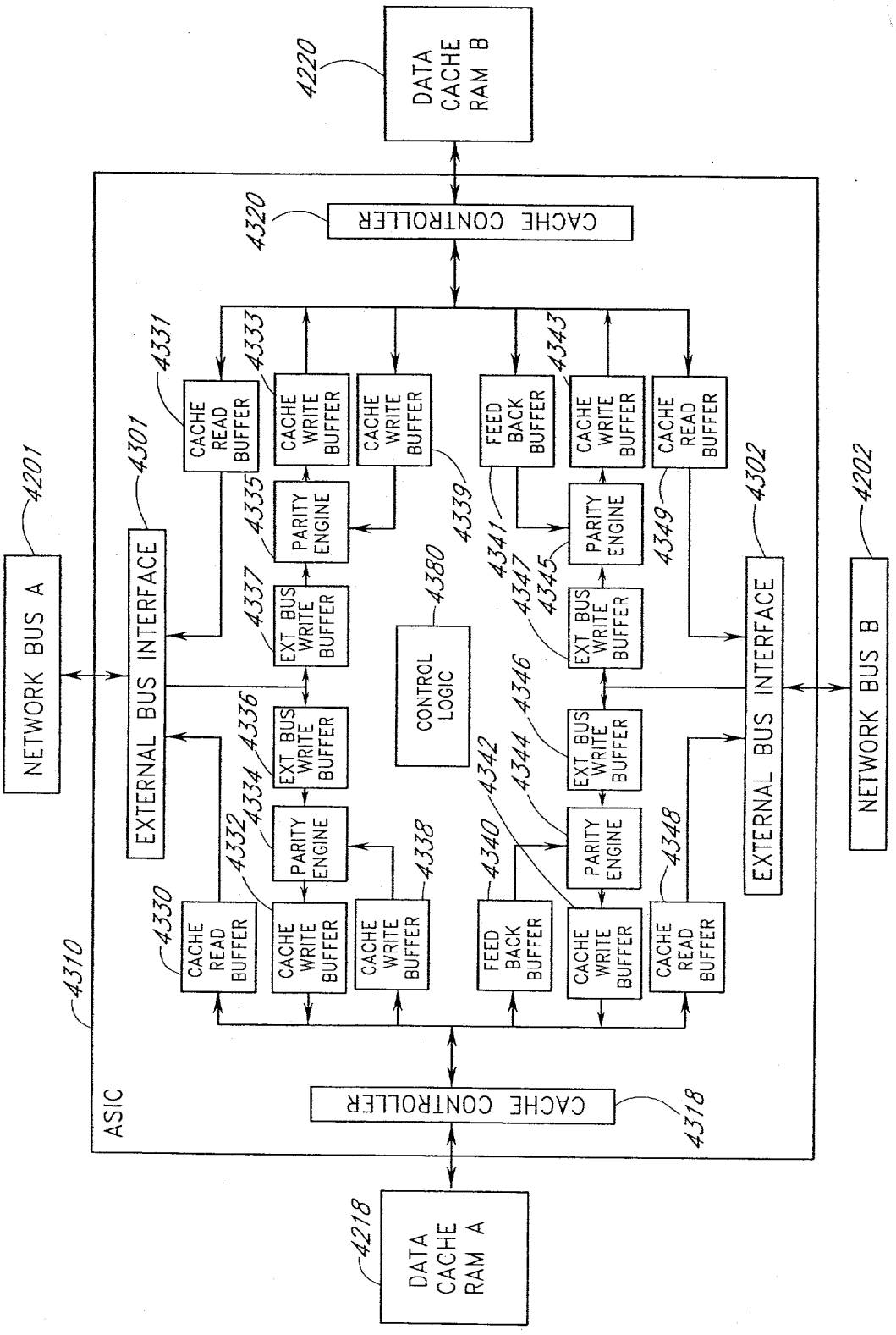

4220
DATA CACHE RAM B
4320
CACHE CONTROLLER
4331
4333
4343
4301
4201
4302
4202
CACHE READ BUFFER
CACHE WRITE BUFFER
CACHE WRITE BUFFER
FEED BACK BUFFER
CACHE WRITE BUFFER
CACHE READ BUFFER
4335
4339
4341
4349
PARITY ENGINE
PARITY ENGINE
NETWORK BUS A
EXTERNAL BUS INTERFACE
4337
4380
4347
4345
EXT BUS WRITE BUFFER
CONTROL LOGIC
EXT BUS WRITE BUFFER
EXTERNAL BUS INTERFACE
NETWORK BUS B
4336
4346
4334
4342
4344
EXT BUS WRITE BUFFER
EXT BUS WRITE BUFFER
4332
4340
4348
PARITY ENGINE
PARITY ENGINE
4330
4338
CACHE READ BUFFER
CACHE WRITE BUFFER
CACHE WRITE BUFFER
FEED BACK BUFFER
CACHE WRITE BUFFER
CACHE READ BUFFER
4310
ASIC
CACHE CONTROLLER
4318
4218
DATA CACHE RAM A

FIG. 43

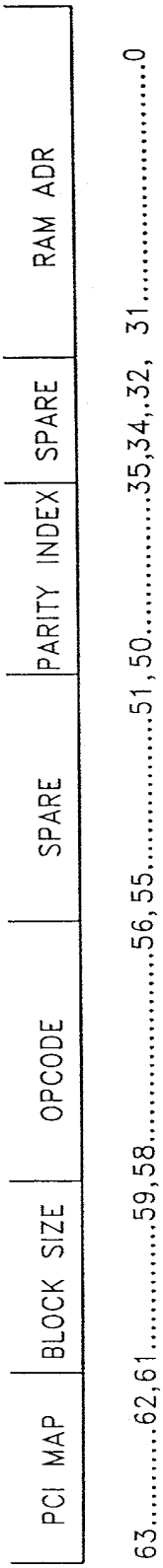

PCI MAP
BLOCK SIZE
OPCODE
SPARE
PARITY INDEX
SPARE
RAM ADR
63.....62,61.....59,58.....56,55.....51,50.....35,34,32, 31.....0
4400

FIG. 44